Arduino Hands-on and Design Resources/Tools for Designers

DESIGN DOCUMENT

Team: sdmay23-48
Client: Industrial Design Department
Advisor: Mani Mina
Team Members/Roles:
Joe Kroeger - Client Interaction
Kyle Todd - Team Organization
Zhengyi Shen - Project Management
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Executive Summary

Development Standards & Practices Used

- Software used is the Arduino IDE
- Engineering standards:
- electrical safety, communication standards

Summary of Requirements

- Industrial Design Student interaction
- Arduino Microcontroller & Tool Kit
- Computer along with Arduino IDE

Applicable Courses from Iowa State University Curriculum

- EE 201
- EE 230
- EE 285
- CPRE 185
- CPRE 288

New Skills/Knowledge acquired that was not taught in courses

- Empathy Map
- Knowledge of the Arduino IDE
- Breadboard usage with a microcontroller
- Interview Procedures

1. Team

1.1 Team Members

Joe Kroeger

Kyle Todd

Zhengyi Shen

Tsung Hsuan Ho

1.2 Required Skill Sets for Your Project

- Arduino experience
- Experience with communication
- Interaction with industrial design students
- Coding / hands on experience
- personnel skills

1.3 Skill Sets covered by the Team

Joe Kroeger - personnel skills, interaction with industrial design students

Kyle Todd - Programming, Breadboarding, Testing

Zhengyi Shen - Arduino / Programming

Tsung Hsuan Ho - Project Management

1.4 Project Management Style Adopted by the team

Agile

1.5 Initial Project Management Roles

Joe Kroeger - Team Organization

Kyle Todd - Testing

Zhengyi Shen - Client Interaction

Tsung Hsuan Ho - Project Management

2 Introduction

2.1 Problem Statement

Our project is to find a way to get industrial design students introduced to Arduino. Arduino is a small controller that builds digital devices. The complicated part of our project is how to implement a way for the design students to use the Arduino within their current design classes/projects without them learning as much of the technical side of the microcontroller. This project will be used in more industrial design classes following the current semester. Arduino has a lot of potential to bring a more technical side to industrial design. These projects can include something as simple as a traffic light or drawbridge to something as technical as a plant watering system. We will work closely with the students of industrial design to pinpoint their needs and their level of understanding of the Arduino. We will observe how they work and how they think in order to guide them to a better understanding of Arduino.

2.2 Requirements & Constraints

Functional requirements

The goal of this product is to enable industrial design students to incorporate Arduino into their own design projects. Industrial Design students should by then have elementary knowledge of the Arduino in order to do basic coding and physical configuration.

Resource Requirements

External resources can depend on the project students will be proposing (this could be a clock, lighting system, or even an automatic plant waterer as a few ideas). The only confirmed project idea currently is a lighting system that will change based on a variance of concepts.

Physical requirements

The physical requirements can vary based on the industrial design student's project. We are going to be working with students to figure out a way to implement Arduino into their designs. The Arduino itself is about 3x2in square microcontroller. The Arduino is less than a pound, but depending on the project, it could add weight.

Aesthetic requirements

The Aesthetic will vary depending on the project. The Arduino will be used to help bring a technological aspect to Industrial Students projects.

User experiential requirements

Industrial Design students and professors. We will be working with Industrial Design students to find ways to teach them how to get comfortable with an Arduino, so they will be able to use it by themselves. We will have interviews with these students to see what level of knowledge they have with programming/Arduino. We will go from here to figure out what necessities they may need for their projects and teach them along the way.

Economic requirements

This project should not take too much resources to carry out. This will be based off of proposed Industrial Design students projects.

Environmental requirements

This will depend on the project. Industrial Design is the practice of designing products, devices, and objects that can be used by millions of people around the world every day. Depending on the projects proposed, we will figure out what effect the external environment has on the system.

UI requirements

The product should be easy to read and follow and should contain all the information necessary to carry out the tasks required.

2.3 Engineering Standards

802.11 ac wifi standard - wifi module on the arduino kit

USB 2.0 - USB ports on the arduino

Software - C coding language / Arduino IDE

Power - Power to the microcontroller

2.4 Engineering Constraints

- Cost: The project should be affordable and accessible for students who may have limited budgets. This may mean using low-cost components or utilizing materials that are readily available.
- Time: The project should be designed to be completed within a reasonable timeframe, as students will have other coursework and responsibilities to manage.

It may be necessary to simplify the project design or reduce the scope to ensure it can be completed in a reasonable amount of time.

- Complexity: The project should be complex enough to challenge students and provide opportunities for learning, but not so complex that it becomes overwhelming or impossible for students to complete.
- Materials: The project should utilize materials that are safe, reliable, and readily available to students. This may require careful selection of components to ensure they can be sourced easily and affordably.
- User-Friendliness: The project should be user-friendly and easy to understand, with clear documentation and instructions for students to follow. This will help ensure that students can focus on learning the concepts and skills, rather than becoming bogged down in technical details.

2.5 Intended Users and Uses

Industrial Design students and instructors will use the final product to learn about the arduino and coding in general. They will use this knowledge to be able to design new innovative projects that will be useful in the real world.

Industrial Design Students

- Persona: This part is fluid. We are just now getting to know these students. More research will be necessary to define a persona.
- Needs for the project: Industrial Design students need to alleviate a challenge because it will bring new successes within new Industrial Design projects.
- Benefits: Industrial Design students will benefit from our project since it brings technology into a design idea they may have. With the Arduino microcontroller, Industrial Design students will obtain the ability to create almost any automation necessary for a design project.

Instructor to the students

- Persona: The instructors are guides and mentors to the students.
- Needs for the project: The instructors need a way to create a new course within industrial design because it will bring new opportunities into the classroom that can be taught to students.
- Benefits: Making a new course that implements Arduino can bring multiple new possibilities within the classroom. Given a chance to learn how Arduino will work can help benefit the students to bring in new design projects and ideas.

3 Project Plan

3.1 Project Management/Tracking Procedures

The team chose the AGILE management system for its flexibility due to the undecided nature of our project. Not having a master plan in place makes the other methods not viable.

The user gains a strong sense of ownership by working extensively and directly with the project team throughout the project by working in agile project management. Since our project is very flexible, each different stage requires user input to improve the project.

Since the project contains short-term deadlines, we have a lot of flexibility in changing the project direction and experimenting with new directions.

3.2 Task Decomposition

Since time schedules with industrial design students are harder to match with ours, we decided to decompose our tasks into subtasks with different team members with one or more to meet up with industrial students to work/interview. Once we finish gathering data required, we gather and then build our project based upon that.

3.3 Project Proposed Milestones, Metrics, and Evaluation Criteria

Our metrics are very hard to quantify with our current situation. We have plans to meet with students, eventually giving us a good metric system.

- Meeting with students to figure out a path for an Arduino project.
- Depending on the student, helping with individual projects.
- Having a final form of the course.

3.4 Project Timeline/Schedule

Our Gantt chart is very vague due to much of the information being human interaction.

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Meet with professors									
Meet with Industrial Design Students									
Take data on what we have learned from industrial design students									
Start working with students on projects implementing Arduino									
Give feedback back to Advisor									

3.5 Risks And Risk Management/Mitigation

The major risk that we have for our project are people who we have scheduled to meet up did not show up. In that case, the probability is random, and in-order to eliminate that risk, we could double-book people so then we have two people working with us in an interview at the same time.

3.6 Personnel Effort Requirements

In our project, we could use the Level of Effort (LOE) system to determine personnel effort. Each task we carry out at different stages of design we will determine the effort estimated and actual effort.

We will continuously meet with design students to see how they work, their needs and what they need to complete their designs.

3.7 Other Resource Requirements

Talking with industrial designs students and faculty will be essential to the success of our project.

4 Design

4.1 Design Context

4.1.1 Broader Context

Area	Description	Examples
Public health, safety, and welfare	How does your project affect the general well-being of various stakeholder groups? These groups may be direct users or may be indirectly affected (e.g., solution is implemented in their communities)	Teaching students will help them to be more self-sufficient in their designs.
Global, cultural, and social	How well does your project reflect the values, practices, and aims of the cultural groups it affects? Groups may include but are not limited to specific communities, nations, professions, workplaces, and ethnic cultures.	With the gained knowledge, designers would not need to seek outside sources for technical needs, thus disrupting work for programmers , etc.
Environmental	What environmental impact might your project have? This can include indirect effects, such as deforestation or unsustainable practices related to materials manufacture or procurement.	Environmental impacts would be minimal. The end product is knowledge.
Economic	What economic impact might your project have? This can include the financial viability of your product within your team or company, cost to consumers, or broader economic effects on communities, markets, nations, and other groups.	The end product will seek to use arduino and sensors, cost is low and the supply of parts is abundant.

4.1.2 Prior Work/Solutions

Not applicable.

4.1.3 Technical Complexity

1. The design consists of multiple components/subsystems that each utilize distinct scientific, mathematical, or engineering principles

Our design is going to vary based on the project. All the designs will have C code and implement a technological aspect with the Arduino. We will have to make a different design based on the Industrial Design student's project.

2. The problem scope contains multiple challenging requirements that match or exceed current solutions or industry standards.

   The challenging requirements with our project is human interaction and the variance of projects. We will have to try and teach about the Arduino along with trying to design a functioning circuit with the Industrial Design student.

4.2 Design Exploration

4.2.1 Design Decisions

Arduino microcontroller - This will be used in all of our designs proposed by Industrial Design students.

Sensors, motors, other devices - These will most likely be needed based on different Industrial Design projects. Some devices may not be used in every single project.

C Code - We will be using C code when working with Industrial Design students. C is very simple to learn and it is used in mostly all embedded systems projects.

4.2.2 Ideation

For our project design ideas will come later with the input from the industrial design students. We did, however, discuss different ways of interacting with the students. We used the lotus blossom method. We determined that each of us would individually make contact with students to get to know them better. Other ideas considered were going in as a group and interviewing students, working directly with faculty, telepathy, using couriers, and watching them work without their knowledge.

4.2.3 Decision-Making and Trade-Off

1. Telepathy
   - Pro - Can be done from home.
   - Con - Not scientifically possible.
2. Using Couriers
   - Pro - Don't have to be directly involved.
   - Con - Could get expensive, not very personable.
3. Watching them work without their knowledge
   - Pro - Get an honest assessment.

- Con - Would probably arouse suspicion.

4. Work directly with faculty
   - Pro - Would get access to the best students.
   - Con - Possible faculty bias.
5. Interviewing students as a group
   - Pro - Information would be known to the group at the same time.
   - Com - Overwhelming to students
6. Making contact individually
   - Pro - More personal, relaxed experience.
   - Con - Group members will have to be constantly updated

By simply weighing the pros and cons we made the decision to approach the students individually.

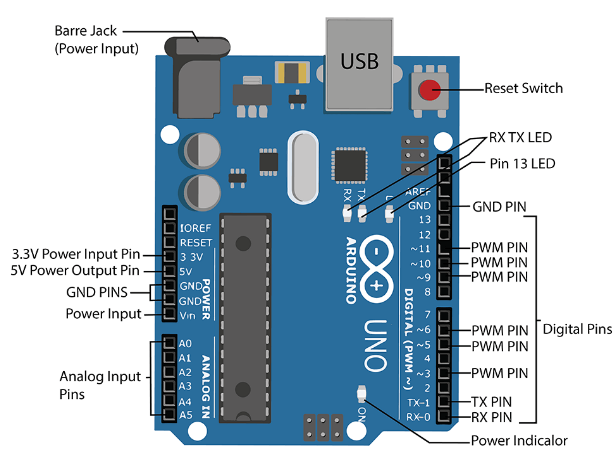
4.3 Proposed Design

4.3.1 Overview

We do not have a fully implemented design. We are working alongside Industrial Design majors to help make the industrial designer's work functional. This can include anything from sensors, motors, lcd screens, buttons, etc. using an Arduino (micro controller). We will work with a few of these students and learn the design process. From here, we will try and make a course that will implement the Arduino into the design process.

4.3.2 Detailed Design and Visual(s)

Our design is not necessarily technical. We are learning about the Industrial Design projects that can implement an Arduino. All designs will implement an Arduino and breadboard. We will use a variety of sensors, motors, lcd screens, buttons, etc. based on the project.



Based on the Arduinos we received, above is a schematic of an Arduino Uno. The Arduinos we are using could be slightly different. Our Arduino will have some C program embedded in it which will be able to run some functionality based on the different projects.

4.3.3 Functionality

The design will be dependent on the Industrial Design student. The final goal will be a course that can be used by the Industrial Design curriculum. Students in the past have come up with designs that have technological designs, but no final functionality. To bypass this, they had to make backup research that proved their design can be implemented. With the course that we are making, Industrial Design students should be able to implement an Arduino into their designs making it a fully functional design.

4.3.4 Areas of Concern and Development

We have to find the projects that can implement an Arduino to satisfy requirements. The user needs will depend on the projects that can implement an Arduino.

We might need a more powerful microcontroller than an Arduino. We will have to ask our Advisor for a better microcontroller than an Arduino.

4.4 Technology Considerations

Arduino:

- Strengths - supports sensors, motors, lcd screens, buttons, etc.
- Weaknesses - limited ports, breadboard required.
- Solutions - Maybe a different microcontroller. We can also use multiple Arduinos.

4.5 Design Analysis

We have been meeting with Industrial Design students as often as possible to find out how the design process works. From our observations and interviews, We have determined that they are not interested in learning more about programming or coding an Arduino. We need to provide the code with a detailed explanation of each line. We will implement their learning process and try to build a course on what we have learned.

5 Testing

5.1 Unit Testing

We designed a lab controlling the color output on an RGB LED. Our tests showed it to be a functional design.

5.2 Integration Testing

Industrial Design students were presented with a prototype lab. They were already working with Arduino kits independently. We were asking for feedback on functionality and clarity.

5.3 Acceptance Testing

The feedback we received was mostly positive. The students were able to understand and build the design.

5.4 Results

The first lab tested well. The outline was easily understood and the language was clear. We did overlook a description of the resistors needed and we were told the flow of the instructions was a little heavy. We need to break them up a little bit more. Also, the test group suggested embedded videos for further clarification.

6 Implementation

6.1 Work Done For 491

Work for 491 was mostly exploratory. Much time was spent debating amongst the team as to the true nature of the project. Our advisor helped us narrow the scope down. We spent most of the time observing the INDD seniors working on their final projects. From there we were able to design a questionnaire to build an empathy map. The data collected in the process helped us better understand the learning techniques and goal of many of the students.

6.1 Work Done For 492

We started work for 492 by meeting as a group with our advisor to make a plan. Our advisor brought a separate group together made up of INDD students and issued them an Arduino tinker kit. They were to be our test group for the labs we wanted to create. Unfortunately, most of this separate group did not respond to our inquiries. The members that did respond to us were able to demonstrate what they were able to do on their own with the provided kits. They also worked with us to better understand the INDD techniques of learning. From their feedback we developed a lab as a prototype and submitted it to the group.

7 Professional Responsibility

7.1 Areas of Responsibility

Work Competence - IEEE says to uphold the highest standards of integrity, responsible behavior, and ethical conduct in professional activities. They are basically saying that they need to acknowledge the safety of their workers, behavior towards each other, and produce good outcomes. This is different from NSPE since they only perform services in areas of their competence rather than exploring new routes of professional competence.

Financial Responsibility - IEEE says to treat all people with respect and fairness. I think this is a little different from the definition, but out of all the IEEE code of ethics I think this suits it best. This is different from NSPE since they mention the act for each employer or client as faithful agents or trustees, while IEEE says to treat everyone with respect and fairness.

Communication Honesty - IEEE says to avoid real or perceived conflicts of interest whenever possible. This is different from NSPE since they mention issuing public statements only in an objective manner while IEEE says to avoid telling anything untruthful whenever possible.

Health, Safety, and Well-Being - IEEE says to avoid injuring others, their ownings, reputation, or employment. Which is different from NSPE since it is more descriptive of what not to do rather than a general being careful with the safety of the public.

Property Ownership - IEEE says to avoid injuring others, their ownings, reputation, or employment. Which is different from NSPE since it goes more into the act to be faithful to other employers and clients. IEEE says to respect others owings and reputation as their own.

Sustainability - IEEE and NSPE do not really have any codes set for the environment here.

Social Responsibility - IEEE says that within most of the rules already covered. I see this as a general wrap up to all other codes talked about previously. NSPE is quite similar since it mentions that the codes are within the usefulness of the profession.

Q1 IEEE	Q2 Importance (High, Medium, Low)	Q3 Team Performance (High, Medium, Low, N/A)
Work competence - don't deceive others in what you are capable of and do work well.	High. For our project since this is mostly focused on human interaction and nothing is set in stone from the start, there are a lot of uncertainties.	High. From the beginning we have talked with our advisor about the different aspects of the project and what the difficulties are and what we can do to solve them.
Financial responsibility - be honest in terms of money and charge reasonable amounts.	Low. Currently, the team is mostly dealing with the Arduino kits we have been given to try out, which could be related. All in all, I don't think the project will have much complexity financially speaking.	N/A. Not much to talk about since we've just been given the Arduino kits. I don't think much else will be needed for the project financially.
Communication honesty - Both say to be honest while communicating with parties involved.	High. Communicating honestly is always important no matter what the project is about.	High. This kind of ties into the first point. We have been communicating with our advisor throughout the process and talking to people related to the project and people in Industrial Design.
Health, Safety, Well-Being - minimize safety hazards to everyone involved. And take the safety of the public seriously.	Medium. With our project, it is unlikely to harm anyone. While our advisor says he has burnt a couple of Arduino boards in the past, I don't think even that is likely to harm anyone either.	High. Our group does take common sense when dealing with electronics.
Property ownership - respect the property and ideas of others.	Medium. As our project progresses we will eventually have sample Arduino projects to include, which will likely take inspiration from other already available ones. This is just one part of our project though.	N/A. Right now we are not at the point of compiling everything we have learned into a final form yet. We are all going through the Arduino kits we have been given, which includes sample projects, which we may refer to while making the sample projects of our own.
Sustainability - Both NSPE and IEEE say to design ethically and keep sustainability in mind.	Low. Our product will not produce a "new product" so to speak, so this probably won't apply.	N/A.
Social Responsibility - Produce products that benefit society.	High. We are working with industrial designs students to enable them to further their projects along the design process on the real world functionality side.	High. We have been talking to industrial design students to see what their needs are in terms of stuff related to functionality and what the difficulties are in implementing those.

7.2 Project Specific Professional Responsibility Areas

Work competence - It applies to our project since we all have to respect each other, the teammates and the people who we are working with. With this project, there are many unknowns in our project because it is primarily concerned with human connection and nothing is predetermined from the beginning.

Financial responsibility - With this project, we don't have much material to work on and prototype. The team is currently mostly focused on the Arduino kits we have been given to test out, which may be connected to this topic. Overall, I don't believe the project will be very financially complicated, as we do not produce a final product based on hardware.

Communication honesty - This is especially important for our project because we are heavily based on human interaction. With this in mind, we have to be very truthful to all the details we are documenting and giving to our working partners. Therefore a high. Throughout the process, we have talked with project participants and industrial designers as well as with our advisor.

Health, Safety, Well-Being - In this project, there aren't many things that could harm the safety or health of anyone. One thing that could be pointed out is dealing with arduino boards. As a team, we are performing very well since we are all very familiar with electronics and therefore won't be causing too many risks while working on arduino boards.

Property ownership - While all projects should respect academic integrity in ideas and designs, with our project we are not trying to develop anything hardware wise, mostly taking on ideas people have had working with cross-field integration ideas and improving on them. I would rate our team performance as N/A. As of this point, we are not compiling the data and work we have gathered yet, as they are very different and scattered. Currently what we are working on is sample projects that were given in the arduino manual, trying to see if we could implement those into our project for easy understanding with the people who do not have much experience with Arduinos.

Sustainability - It doesn't relate to our project mostly because we are not essentially producing anything new. We are building upon ideas and translating them into a reusable template that serves a prudent purpose of connecting two different workflows into one, therefore we don't have a score.

Social Responsibility - We are highly responsible for the results because it would directly affect how industrial design students will continue to think about how they will approach their design while working in the industry. I think we are Highly performing in this section as we have been speaking with industrial design students to learn more about their functional needs and the challenges they are facing in putting those needs into practice.

7.3 Most Applicable Professional Responsibility Area

The most important professional responsibility that is both important to our project and team is social responsibility. Our project is highly human interaction based. We are there to help industrial design students with their projects and teach them how to use an arduino. We have demonstrated this responsibility by going in a few times a week to talk with some of these students about their major and projects they are working on.

8 Closing Material

8.1 Discussion

Our project felt more personal than technical. Industrial Design was a foreign world to us before we started our work. Our research helped us to better understand the thinking process of an INDD student. We spent many hours watching them work and getting to know them individually. The results of our research were summarized in an empathy map. Working on the empathy map helped us to get to know their routine in a more intimate way. We were able to not only get a good feel for how they worked, but also why they worked. This was the most important aspect of our project.

We learned that many INDD students are frustrated engineers. They share many of the same abilities as engineering students, they just have a block that they need to get around. Some say they hate coding, others say they hate math, but all of them are capable. They all seem to be open to learning new skills that they can put in their “toolbox”. They are eager to try most anything and they are very thorough in the documentation, helping them to learn from their mistakes.

8.2 Conclusion

We have spent many hours with the senior students of Industrial Design. Our goal was to understand how they think. We watched them work and studied their techniques. Interviewing the individual students gave us the information necessary to move on to the next phase of our project.

The biggest constraint we had during the early phase was the availability of the students we were observing. We had to arrange our schedules around theirs. If we had started interacting with the Industrial Design students earlier, we could have achieved our goals much faster.

Working with INDD students who were independently tinkering with Arduino kits was a great resource. We needed greater participation from that group, however. Schedules were almost impossible to align during our very busy pre graduation semester. Those who did interact with us gave us invaluable information.

INDD has a busy curriculum and they simply do not have the time to learn a subject they have no interest in. They were mostly opposed to learning code, so we concluded that code should be provided to them, with line by line explanations. Exercises within the labs they work on could be provided to help them better understand the code without slowing them down.

INDD students for the most part enjoy experimenting. Many times their experiment leads to failure, but this is where they feel they learn the most. Lab should be designed for them to experiment, and fail if necessary.

In order to keep the attention of a typical INDD student, labs should be designed with applicable functionality in mind. Examples would include controlling LEDs, controlling motors, or controlling sounds. They will be more attentive to a lab that could work into a design idea. Better yet, a lab could help inspire an original design idea.

We were the first group to work on a project of this nature. Advice for future groups working on a similar project would be to start working with INDD students as soon as possible. Work with sophomores or juniors since they are more likely to implement these lessons. However, do not dismiss the seniors. You can learn a lot from their perceived missed opportunities.

8.3 References

SIK Inventor Guide

8.4 Appendices

Appendix I - Alternative/ other initial versions of the design (and why they were scrapped in favor of the current version)

Starting this project, our team was very adamant to teach the industrial design students the same way us engineering students have learned. We thought about lectures and labs for them to learn how to program and circuit building for the Arduino. We learned quickly that this was not the case. Industrial Design classes are a lot different than our engineering courses. They create an idea, usually of personal interest, and proceed by making sketches, creating prototypes, and then the final product. This may seem similar to what an engineering student may be, but they create non-technical products due to the limitations of a technological background.

Our team had to scrap all our initial thoughts and learn from the Industrial Design students. We attended multiple Industrial Design lectures taking notes and finding ways how we can implement these ideas into our own project. Our team had to start from base zero and use tactics learned from the Industrial Design department to help teach the students how to use an Arduino.

Appendix II: Other Considerations. Here you may include any other points you deem worthy of being mentioned, like what you have learned, anything funny (but relevant) that happened during the design process, etc.

Our team learned that we are teaching students how to program and circuit build with no technological background. This was very hard, but using the methods we learned from their courses had helped a lot. We needed to go into every little detail on how each component and line of code works. It was a difficult task. We came to the conclusion that giving the students the circuit diagram and code was the best way to move forward. We created an instructional lab that went into each section of the component and corresponding code. The code was the harder part which we made optional. If the students wanted to create their own project using the Arduino, they were able to look back at this lab as a reference tool. We received positive feedback from the students in doing so.

8.4.1 Team Contract

Team Members:

1) Kyle Todd 2) Zhengyi Shen

3) _______Joe Kroeger______________ 4) ________Tsung-Hsuan Ho________

Team Procedures

1. Day, time, and location (face-to-face or virtual) for regular team meetings:
   Tuesday afternoon and Thursday in class
2. Preferred method of communication updates, reminders, issues, and scheduling (e.g., e-mail, phone, app, face-to-face):
   Virtual, communication via Discord
   When the project construction starts, we will have more face-to-face meetings. (TLA)
3. Decision-making policy (e.g., consensus, majority vote):
   Consensus of majority of members
4. Procedures for record keeping (i.e., who will keep meeting minutes, how will minutes be shared/archived):
   Keep records in Team google drive. Members will keep track of their own time.

Participation Expectations

1. Expected individual attendance, punctuality, and participation at all team meetings:
   a. Team members will attend regular team meetings
   b. It is fine if a team member can't attend with a heads up beforehand
2. Expected level of responsibility for fulfilling team assignments, timelines, and deadlines:
   a. Team members will complete all assigned tasks and help out individuals who are having difficulties understanding technical details.
3. Expected level of communication with other team members:
   a. Team members will communicate and respond within a reasonable time frame and notify other members of absence in advance and make sure that It does not hinder the work of anyone else on the team.
4. Expected level of commitment to team decisions and tasks:
   a. Everyone will be given a task to complete every week and will be expected to have it done within the timeframe that is fair

Leadership

1. Leadership roles for each team member (e.g., team organization, client interaction, individual component design, testing, etc.):
    a. **Team Organization** - Kyle Todd
    b. **Client Interaction** - Joe Kroeger
    c. **Project Management** - Zhengyi Shen
    d. **Testing** - Tsung Hsuan Ho
2. Strategies for supporting and guiding the work of all team members:
    a. Everyone will be given a task to complete every week and will be expected to have it done within the timeframe that is fair
    b. If a member does not complete their task, other members will give them support or help to finish their task.
    c. If a member feels that they cannot complete the work, notify the other team members.
3. Strategies for recognizing the contributions of all team members:
    a. Post-week surveys will be helpful seeing what all gets done
    b. Assigning a task to each person every week will also help see what gets done from each team member

Collaboration and Inclusion

1. Describe the skills, expertise, and unique perspectives each team member brings to the team.
   Zhengyi: Fluent in PHP and css, experienced in Java
   Kyle: Java, C/C++, Arduino experience, little electrical breadboard work
   Joe: Circuit design, power analysis, some C and logic circuit experience
   Jonathan: Circuit design, C/C++, Arduino/Raspberry Pi and some Python.
2. Strategies for encouraging and supporting contributions and ideas from all team members:
   We will be open to all ideas. We will take every idea into consideration and come to a consensus on which idea would be the best. Then every member will be given a weekly task to complete based on our main design idea.
3. Procedures for identifying and resolving collaboration or inclusion issues (e.g., how will a team member inform the team that the team environment is obstructing their opportunity or ability to contribute?)
   We have a fairly small team so all members are encouraged to participate fully. If any team member falls behind, the other members will communicate expectations. Also, any member that feels their ideas are not given proper attention can call a meeting of the other members to discuss the given issue. Further grievances can be brought to the attention of our sponsor or Dr. Fila.

Goal-Setting, Planning, and Execution

1. Team goals for this semester:
   Getting to know the arduino and get the design requirements of the industrial design students
2. Strategies for planning and assigning individual and team work
   Everyone should get to know the Arduino and its capabilities
3. Strategies for keeping on task:
   Assigning a task to each person every week will also help see what gets done from each team member

Consequences for Not Adhering to Team Contract

1. How will you handle infractions of any of the obligations of this team contract?
   If a task does not get done, we will have a talk with that certain member and ask if help is needed or why the task did not get done. No major punishments, just a way to give a helping hand in certain areas.
2. What will your team do if the infractions continue?
   If the infractions continue, we will have to talk to the professor about the situation and obtain thoughts on what to do.

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a) *I participated in formulating the standards, roles, and procedures as stated in this contract.*
b) *I understand that I am obligated to abide by these terms and conditions.*
c) *I understand that if I do not abide by these terms and conditions, I will suffer the consequences as stated in this contract.*

1) ____________Kyle Todd________________________________ DATE _____9/22/22________
2) ____________Joe Kroeger______________________________ DATE _____9/22/22________
3) ____________Zhengyi Shen____________________________ DATE _____9/23/22________
4) _____________Tsung Hsuan Ho_________________________ DATE _______9/23/22_______