

1. Introduction

1.1. PROBLEM STATEMENT

The current way that students in CPRE 2880 learn and engage with concepts presents several challenges that hinder effective learning. One of the main challenges that students face is not getting enough practice of the material due to limited opportunities and resources provided. The students may receive very little feedback on homework submissions due to the TAs not having enough time to provide meaningful feedback for every student in the course. This causes students to be left questioning what they did wrong, preventing any sort of improvement and understanding. When students would like to seek out the professor or TAs to get feedback or to learn more about concepts they don't understand, they are met with limited office hours and other students competing for instructor attention. Additionally, there is limited lab seating and microcontrollers (Cybots) for the students to practice programming, further impeding hands-on learning.

Department faculty is committed to improving the student experience. Instructors have limited time, but it is not due to lack of caring. Professors must balance classes, research, and more, while TAs fit their responsibilities between their own classes. The obstacles the students face are not as simple as poor curriculum or instruction. For many classes, especially these large core classes, there are simply too many students for current teaching methods. Some students will slip through the cracks in these technical courses, but the CPRE 2880 professors are looking to minimize that as much as possible. These obstacles are not unique to this course either; throughout the department and even the whole campus, there are professors aiming to improve student understanding. There are some tools already commonly used, but each has its own flaws and many fall short in technical classes. What is needed is the adoption of a new technology, infinitely customizable, and infinitely randomizable to generate instructor-approved questions for students.

From all of the challenges that students face during their time in CPRE 2880 (and similar courses), it is clear that students need a way to access learning opportunities whenever they want that will provide feedback based on their mistakes. An effective solution would ensure that students can learn at their own pace and receive instant feedback to guide their progress. Additionally, professors and TAs need a way to significantly reduce their time spent on writing questions or grading homework and exams so that they can focus on teaching and offering personalized support to their students. By optimizing these aspects, both students and educators can benefit from a more efficient and effective learning environment.

1.2. INTENDED USERS

The product that we are creating is for the benefit of making the CPRE 2880 course easier to learn and manage. The main users of our product will be the students, professors, and teaching assistants in CPRE 2880. Each user of our product has their own unique expectations

for the course, and we have made sure to incorporate each of their needs to ensure every user will be satisfied with our product.

The students of CPRE 2880 are usually sophomores who have little to no experience with embedded systems and embedded programming. Depending on their major, they may have never done any type of programming before. They will also experience different types of emotions throughout their time in the course, like feeling frustrated or overwhelmed with some of the more difficult topics taught in the course. We assume that they want to take CPRE 2880 to learn the basics of embedded systems and aim to do well in the course. In order for them to get a satisfactory grade in the course and have a solid understanding of the concepts taught, they will need specific and quick feedback on assignments. This is imperative for students to learn from their mistakes and improve their knowledge. To improve their learning of concepts that they don't fully understand, they will need access to questions that are engaging and interactive. Furthermore, they need questions that can be randomized for unlimited practice. With our product, students will get access to questions that offer much more interaction than what they currently get from their homeworks. Interactive questions will be more effective at capturing student attention, and making sure even unmotivated students engage with the material. Each question hosted from our product will also allow students to create unlimited variants for every question, allowing them to practice difficult questions as many times as they'd like. Overall, our product will enhance students' learning in CPRE 2880.

For the professors of CPRE 2880, they are often busy juggling different things, such as their research, multiple classes, and their personal life. This makes it hard for professors to spend more time explaining difficult concepts and having one-on-one time with students. However, professors want their course to be successful and their students to grasp every concept taught. To help professors multitask, they need homework and quiz questions to have an autograde function to save them time on grading. They also need a way to make concepts easier to understand for their students. This improvement of teaching material will lead to excellent student performance in their course. To help students learn concepts at their own pace, professors also need to provide students with questions that can be randomized. Instead of a static set of questions, students are able to practice until they are satisfied with their grade and their understanding. With our product, we will provide professors with the tools they need to make their course more successful for students.

The TA's for CPRE 2880 are typically juniors, seniors, and graduate students majoring in a similar field and have experience with embedded systems. They're most likely very busy with other schoolwork and research, and depending on their status, undergraduate TAs are only allowed to work 10 hours a week while graduate students are allowed 20 per week. This means they have limited time to help students and grade assignments, which is why they need a way to spend less time grading assignments and focus on giving better feedback to students. Our project plans to have almost all questions be auto-graded, which will help reduce the time that TAs spend grading each week. This allows the TAs to spend more time grading the non auto-graded questions and allows them to give better feedback to the students.

Finally, we aim for our project to be a model for other courses to follow. We hope to inspire other instructors to revitalize how they teach material and use their time more efficiently. Through the new approach this technology brings, we aim to improve all our users' experience- we do not want a product that assists the teachers but makes students' lives harder. Students, TAs, and professors have very different approaches and goals when it comes to a course. Through our implementation of our PrairieLearn solution, we aim to keep the user experience in mind and develop a product that will satisfy our users' needs.