

# Guided Undergraduate Training for Shark Segmentation (GUTSS)

Amy Wu\* amy.wu@ufl.edu University of Florida Gainesville, Florida, USA

Morgan Cobb\* morgan.cobb@ufl.edu University of Florida Gainesville, Florida, USA

Victor Perez vjperez@smcm.edu Department of Environmental Studies St. Mary's College of Maryland St. Mary's City, Maryland, USA

Christan Grant christan@ufl.edu Department of Computer and Information Science and Engineering University of Florida Gainesville, Florida, USA

## ABSTRACT

As artificial intelligence (AI) becomes more ubiquitously used in education, the need to provide instruction around AI skills will increase. This work presents an opportunity for students to develop image manipulation skills through segmentation. Guided Undergraduate Training for Shark Segmentation (GUTSS) is a mobile application that enables students to use these skills while simultaneously learning about marine anatomy. To make the connection between AI and science education, in-service science teachers can use the software inside and outside of the classroom to help students learn about different aspects of shark anatomy through the GUTSS. Through the application, teachers can enrich their classroom curriculum with technology, share materials, grade assignments, and view their students' work. GUTSS uses open-set object detection, image segmentation, and image manipulation to assist users with organ identification. Gamification within the application will make learning shark anatomy more engaging to students. Prior work from the NSF ITEST Award indicates teachers' willingness to integrate AI concepts into the classroom aligned with state standards. Further wireframing of the application from instructor perspectives is ongoing, to incorporate teacher viewpoints from mixed-methods survey responses on AI usage and anatomy. Future work aims to supplement shark dissection images from AI generation of anatomical image data sets, by collecting these data from students and teachers. Ultimately, the application will be able to identify nonaquatic organisms' anatomical features as a tool for students to learn.

## **CCS CONCEPTS**

• Software and its engineering → Designing software; • Applied computing  $\rightarrow$  Interactive learning environments; • Human**centered computing**  $\rightarrow$  Scientific visualization; • Computing methodologies  $\rightarrow$  Image segmentation.

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Jeremy A. Magruder Waisome jam323@ufl.edu Department of Engineering Education University of Florida Gainesville, Florida, USA

## **KEYWORDS**

AI, ML, Segmentation, Anatomy, Education, Science, Gamification

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Figure 1: GUTSS application segments a dogfish dissection image. It labels many of the internal and external structures to aid K-12 students. (This is a modified image [5].)

#### 1 INTRODUCTION

Teaching the younger generation about AI needs to start with education's fundamental base: the teachers. Despite a lack of inservice teachers on AI integration with their existing curriculum, prior research indicates teachers' willingness in professional development opportunities for advanced technological concepts, like AI [8]. During a week-long teacher professional development workshop, middle school science teachers learned how to introduce AI concepts and machine learning models using fossil shark teeth in their classrooms throughout an academic year. Teacher and student data collected from the project indicated increased self-efficacy for

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both students and teachers around understanding and using AI [8]. These preliminary data led authors to consider other ways science teachers might use AI with sharks and similar species.

Many K-12 schools cannot access the necessary equipment required for hands-on animal dissections for students. The experience requires not only a financial cost for an operation with a limited number of student participants but also a controlled environment to maintain order and minimize clutter around the cadaver. After the anatomy lesson, students cannot revisit the activity at their own pace, rather only relying on their recollection.

We aim to provide an accessible and affordable anatomy learning alternative to secondary school students and teachers by using deep learning and educational gamification. In particular, GUTSS provide affordability through its open-sourced content. Users can use and adapt to how its interface would be used, catering to how the students understand marine biology in the classroom at their own pace. Related works like the MERLIN Project and Seek by iNaturalist use AI to reinforce content comprehension through interactions [4]. Therefore, we propose *GUTSS*, a mobile application to simulate shark anatomy dissection with AI in the classroom. Teachers will be able to create their own organ identification assignments for their students to earn points. GUTSS uses zero-shot object detection, image segmentation, and image manipulation, to automatically label anatomical structures to evaluate students and provide students feedback on their learning progression.

## 2 THE GUTSS APPLICATION

The GUTSS application has a teacher-mode and a student-mode. Teacher-mode allows the invitation of students to complete a set of assignments. Teachers may add new or pre-labeled images as assignments. Students in student-mode are assigned a classroom and activities to complete. Users can use either mode to take pictures and initiate an auto segmentation. In student-mode, students are expected to label segmented portions for reward points, demonstrating how much the student achieved thus far. Instructors' survey responses will strengthen GUTSS development for classroom usage for teacher-mode and student-mode.

GUTSS employs a fine-tuned Segment-Anything-Model (SAM) [2] and Grounding DINO [3] to identify organs and other animal anatomical structures (See Figure 1). Specifically, GUTSS employs zero-shot object detection, image segmentation, and image manipulation to grade the student assignments for points as part of an educational game. First, the SAM model segments images of organs; GUTSS will then highlight the shark organ through semantic segmentation [2]. Afterwards, the student will answer the identified organs' labels for the assignment. GUTSS will grade the student labels with Grounding DINO. [3].

The app in initial testing will use small anatomical data-sets, leaving room for efficiency improvement [7]. The teachers' added labels and corrections to student submissions are added to GUTSS' internal training data set. As assignments are submitted, GUTSS is retrained and improves in accuracy.

With gamification, students increase their class material comprehension through the GUTSS mobile application's gameplay [1]. AI enrichment and reward system makes the online learning process more engaging for the students [4]. AI will also familiarize with the user, offering dynamic anatomical assessments on course content in response to his or her need of shark understanding.

We received nine responses to a questionnaire on K-12 instructors experience of technology platforms, AI knowledge, and shark dissections. The results are that majority use AI and are willing to use it in education, seeing it as an potential alternative perhaps toward animal dissection support. Moreover, we are looking to send out a follow-up survey to said instructors on potential key features and user interaction with course material and AI usage. Upon further revisal and review, the application will be sent out to be tested live in classrooms with shark dissection.

As a follow-up study topic, shark dissection is a precursor to include other organisms to increase our understanding on biodiversity. Therefore, GUTSS will meet the increasing student demand to understand the way AI operates [6]. It encourages them to think about AI impact on shark dissection and elsewhere.

## 3 SUMMARY

Instructors are fundamental to students' learning. Their eagerness to network led to conferences like shark teeth identification with AI. As teachers learn how AI works, students learn it from the teachers.

One concept involves diving into shark anatomy. However, secondary school classrooms lack the proper equipment and secure environment. As a result, many students are unable to dissect sharks. Therefore, we aim to develop GUTSS, an accessible and affordable mobile application with AI and gamification. It provides incentive for the students' achievements in game. Furthermore, it will offer more engagement in classroom learning, gaining more accuracy automatically through students' labels and instructor feedback. Hence, schools will not only have a humane alternative to dissecting sharks, but also at a lesser cost.

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