



FOSSEE Summer Fellowship Report

On

Creating Spoken Tutorials for PhET Simulations

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August 29, 2022

Acknowledgment

I would like to express my gratitude for getting the opportunity of pursuing the FOSSEE Summer fellowship at IIT Bombay. Not only has this been a great learning curve but also introduced me to some of the most brilliant minds and gave me a humbling opportunity to work with them.

I would like to thank Ms. Madhuri Ganapathi, Dr. Snehalatha Kaliappan Ms. Vineeta Ghavri, Ms. Rashmi Patankar for their constant guidance and support for the entirety of the fellowship. Their constant evaluation helped me stay consistent with my work, learn new concepts and produce fruitful work. I would also like to thank Prof. Kannan M Moudgalya for providing this opportunity.

I am forever grateful for this opportunity as it helps me blot a professional development in my career trajectory. I hope to work with FOSSEE and the Spoken Tutorial team again in the future.

Contents

Chapter 1

Overview

Spoken Tutorial is a multi-award winning educational content portal. Spoken Tutorial and FOSSEE (Free/Libre and Open Source Software for Education) are projects at Indian Institute of Technology Bombay.

PhET Simulations is a part of the many projects done under Spoken Tutorials. During the entirety of this fellowship I produced 5 PhET simulations. These catered to Mathematics and Physics domain. The process included understanding the simulation, creating a script and slides and further recording it. This report is conclusive of my contributions to the same.

Chapter 2

Spoken Tutorial

2.1 Spoken Tutorial Project

Spoken Tutorial is a multi-award winning educational content portal. It provides numerous different resources on free as well as open source software so that any user can learn them at their own convenience. It also provides the freedom to choose from multiple languages. According to their expertise, a learner can choose from courses ranging from Beginner to Advanced level. To ensure the active participation of the learner, the tutorials include side by side practice as well. The Spoken Tutorial project is funded by the National Mission on Education through Information and Communication Technology (ICT), launched by the Ministry of Human Resources and Development, Government of India. In these times where digital learning has become increasingly popular, initiatives like the Spoken Tutorial Project are of vital importance.

2.1.1 Process of creating a Spoken Tutorial

- **Outline:**
An outline for the topic is created to help us get a basic understanding of the subject and to give some idea about the structure and sequence of the overall tutorial.
- **Script:**
A script is the written form of the spoken tutorial. Each sentence said during the recording is according to the script. This is made according to the guidelines by the ST team. For a good spoken tutorial, the script needs to be simple with appropriate visual cues.
- **Slides:**
Slides are made to help explain certain topics in the script. They are made corresponding to the script. LaTeX Beamer environment is used to create the slides. For a specific FOSS, templates are used to make the slides. These slides should follow the guidelines given by the ST team.
- **Novice check:**
Novice check is done by a person who has a very little knowledge about the

ST to make sure that the script and slides are easy to understand. The novice also points out mistakes made in the script and slides.

- Recording:

The video is made according to the ST guidelines. Extra care is taken to minimize mistakes and ensure the proper quality of recording.

- Review:

After the above steps, all the related files are sent to the reviewer who verifies the recording and files according to the spoken tutorial guidelines and checklist. This is to ensure a good quality of the content being uploaded. Once all the criteria is met, the reviewer publishes the tutorial on the spoken-tutorial website.

Chapter 3

PhET Simulations

3.1 PhET Interactive Simulations

PhET is an acronym for Physics Education Technology, a not for profit initiative by University of Colorado, Boulder. This project was started in 2002 by Nobel Laureate Carl Wieman. All the simulations are available freely at their website-<https://phet.colorado.edu/>. They can even be downloaded for offline use and can be converted to html or java versions, which helps in their accessibility through the browser. These simulations are interactive and impart practical knowledge in various STEM subjects particularly aiding the K-12 and high school students.

Due to the facilitation of the visualisation of the simulation, children's learning is facilitated at a better speed. The well coordinated colors and animations add to the enhancement of the simulation.

3.2 PhET Simulations for Mathematics

My greater chunk of contributions are for Mathematical PhET simulations. The PhET simulation for Mathematics aim at simplifying the complex operations to simpler children-friendly animated interface. These operations are broken down to simpler bits in order to facilitate the visualisation of how these operations operate on the numbers.

3.3 PhET Simulations for Physics

A larger comprehension for the subject of Physics is achieved by gaining the practical application of the subject. The PhET simulations for Physics help in gaining better understanding on these concepts like reflection of light, refraction etc.

I have explored 5 different simulations, 4 in mathematics and 1 in physics. To gain a better understanding of these simulations, I went through the resources like teaching material offered by the simulation website. The details of these simulations are explained further.

Chapter 4

Contributions

4.1 Creating Spoken Tutorials for Mathematics PhET Series

In the Mathematics PhETs, I have worked on 3 tutorials:

- Vector Addition
- Curve Fitting
- Graphing Quadratics
- Least-Squares Regression

4.1.1 Vector Addition

This tutorial explains the concept of a vector, how they can be presented in one dimensional and two dimensional coordinate axis, their addition and subtraction, the displacement caused by these operations and scalar multiplication.

The vector addition interface has 4 screens, namely Explore 1D, Explore 2D Lab and Equations. As the name suggests the first two screens is about exploring one dimension and two dimensions of a vector. The Lab screen is to be performed as an assignment. The equations screen is to explore further operations on vectors. Accordingly, I wrote the script, and with proper feed backs and guidance the finalised script was converted to slides for further recording.

4.1.2 Curve Fitting

Curve Fitting is a single screen simulation. It explores three types of curves, Linear, Quadratic and Cubic. The data points are to be plotted on the Cartesian planes. Then deviations and residuals are also measured. It also measures the deviations by taking into consideration two measures namely chi squared and r square. It also describes a best fit and adjustable fit option.

After exploring and understanding the simulation, I wrote the script and made the slides for this tutorial. After it was checked by my mentor and a novice, I recorded it for further processing.

4.1.3 Graphing Quadratics

This tutorial is an extension to the previous one. But it only focuses on a quadratic curve- parabola.

This tutorial has 4 screens- Explore, Standard Form, Vertex Form, and Focus and Directrix. All of them have vertex, directrix, focus and line of symmetry. As the simulation progresses all these concepts and their parameters are explained further. I wrote the script and made the slides for this tutorial. After it was checked by my mentor and a novice, I also completed its recording.

4.1.4 Least-Squares Regression

The Least-Squares Regression is a single screen simulation. It demonstrates the concept of a best fit line, residuals and correlation coefficient that show how strong the relationship is between two variables.

This simulation has a few inbuilt data sets that can be plotted and their relationship can be assessed accordingly. The best fit lines are compared as againsta customised lines. After exploring and understanding the simulation, I wrote the script and made the slides for this tutorial. After it was checked by my mentor and a novice, I also completed its recording.

4.2 Creating Spoken Tutorials for Physics PhET Series

In the Physics PhETs, I have produced 1 tutorial:

- Geometric Optics

4.2.1 Geometric Optics

Concepts like optics, lenses, mirrors, focal length etc are explored in the geometric optics simulation.

This simulation has 2 screens. Lens and Mirror. The first one discusses about convex and concave lens and introduces real and virtual images. It also demonstrates what various parameter values like radius of curvature, refraction, optical axis, rays and diameter. The second screen discusses 3 types of mirror- Convex , Concave and Flat mirror. I produced a script accordingly. After it was checked by my mentor and a novice, I also completed its recording.

Chapter 5

Novice Check

In the Mathematics PhETs, I performed the novice check for 2 tutorials:

- Number Line: Distance
- Number Line: Integers

In the Chemistry PhETs, I performed the novice check for 2 tutorials:

- Sugar and Salt solutions
- Semiconductors

Chapter 6

Professional outcomes

Professional skills developed during this internship are:

- LaTeX coding to make reports and presentations
- Video recording and learning the related soft wares
- Time management and Discipline
- Interaction with other fellow interns and coordination with the teacher

Chapter 7

Challenges

The challenges that I have faced during my fellowship are as follows:

- Time Management
- Re-recording due to mistakes
- Background disturbance in recording
- Untimely submissions
- Maintaining daily report

Chapter 8

Conclusion

In conclusion, being a part of the FOSSEE Summer Fellowship 2022 was a very enriching experience. It has opened a new dimension of learning for me. It helped me to learn how a video is produced from scratch and what happens in behind the scenes while making them. From making the script, to making slides and then recording it.

This process also enabled me to come in contact with the basics in STEM concepts. I also networked with my fellow interns and mentors, learnt the discipline of meeting my goals on time and achieved a sense of time management while doing so.

I feel quite privileged to be a part of this fellowship whose underlying goal is to give back to the society and contribute to the educational sector of our country. It is really gratifying to know that my contributions would be further used in manners that would enable someone derive fruitful learning's form these videos.

Chapter 9

Useful Links

9.1 PhET Simulations for Mathematics

Vector Addition :

<https://drive.google.com/drive/u/0/folders/1-9X9wwpNTSV29haoGszB98UxsGo0WhU5>

Curve Fitting :

<https://drive.google.com/drive/folders/1WSNUeWX3C0c9cSocM1jRDm04Lib7j2o0>

Graphing Quadratics :

<https://drive.google.com/drive/folders/1e5soFjh6lvn-rM7M-JwPn8yb0rZGbvJj>

Least-Squares Regression :

<https://drive.google.com/drive/folders/11EYU070T5gTW1xVVDk5EF5sXkPU8TZcP>

9.2 PhET Simulations for Physics

Geometric Optics :

<https://drive.google.com/drive/folders/1NXBT5QqXf84Krn9U6FVUmbenf5NfNN23>

9.3 Recordings

https://drive.google.com/drive/u/0/folders/1Is_ef0E1kxNj7v8IjS9BLrkGbsh6_m11

9.4 Reference

- <https://spoken-tutorial.org/about-us/>
- <https://spoken-tutorial.org/>
- <https://phet.colorado.edu/>