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Project: Shape

Team 4

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1. INTRODUCTION

1.1 Purpose

This document describes the architecture and system design of a software built to calculate dimensions of cube/pyramid that can be built with maximum utilization of a user given length of wood.

1.2 Scope

The Scope of this project involves creating a system which calculates the dimensions of a cube/pyramid, as per user's choice, with maximum volume that could be created from the user given length of a wood. This shape is rendered along with its dimensional information.

2. SYSTEM OVERVIEW

Entire system is developed as a web application with a flexible user interface to switch between an American or metric unit system. A MVC (model-view-controller) pattern is utilized to build the system that can evolve with time.

3. SYSTEM ARCHITECTURE

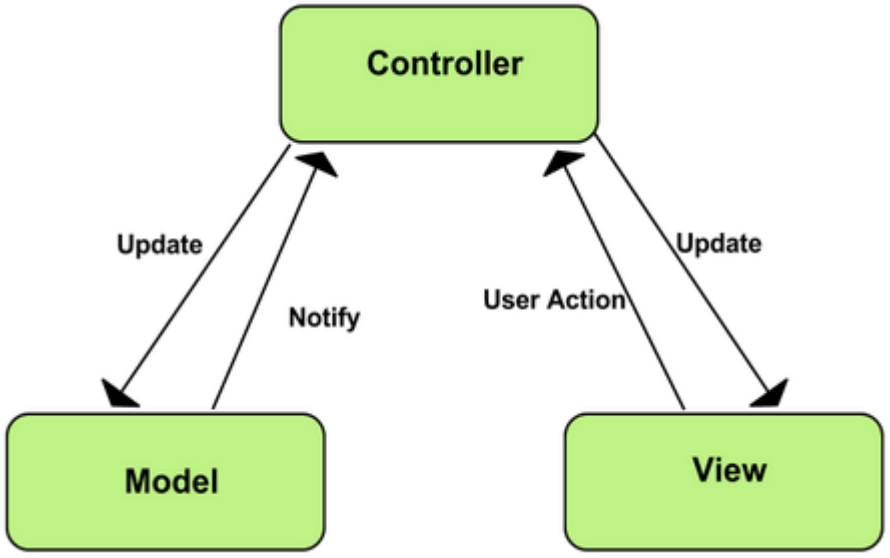
3.1 Architectural Design

The Entire web application is designed using a model-view-controller architecture using angularJS framework.

- To update the model's state, a **controller** can send commands to the model. It can change the view's presentation of the model by updating the model's state.

- A **model** interconnects controller and view. The output is displayed in the view by storing data that is retrieved according to commands from the controller.

- Based on changes in the model, **view** generates an output.



3.2 Decomposition Description

In our project the view for the web application is created using HTML and CSS. The view provides the user with a shape selection tab and a form for user to specify the length of the piece of wood and choose a measurement unit system in which the length is provided. This length is used to calculate the dimensions of a cube/pyramid with maximum possible volume and is displayed with related details like maximum possible length.
The model contains the logic to calculate the maximum volume and maximum base/slant length that is possible given the maximum length of the material (e.g.: wood).
The controller is responsible for responding to user input and perform interactions on the data model objects. The controller receives the input, it validates the input and then performs the logic provided by the model to calculate the necessary details and initiates the view to change based on it.

3.3 Design Rationale

The implementation of the user interface is done by software architectural model called Model–view–controller (MVC). This model separates the internal representation from information given or taken from user by using three interconnected parts. This design pattern offers various advantages over other types of design patterns (e.g.: MVP and MVVM) such as efficient modularity, ease of growth and a powerful responsive user interface.

4. Component Design

The view designed using HTML and bootstrap contains a form which enables the user to input the length of the wood used along with its American unit system or metric unit system.

The controller validates the input by making sure the input is a number and is within bounds.

Cube
Based on the given length of the wood the maximum side of the cube is calculated in the model using the below formula

Max cube side = length of the wood / 12

The volume of this maximum possible cube is then calculated using the formula
Max Cube volume = (Max cube side * Max cube side *Max cube side)

After calculating the max cube side length and max cube volume the view is then updated with a 3D representation of this cube and these values.

Rectangular Pyramid
The volume is maximized by making it a regular rectangular pyramid. Based on the given length of the wood the maximum side of the pyramid is calculated in the model using the below formula

Max pyramid side = length of the wood / 8

The volume of this maximum possible pyramid is then calculated using the formula
Max pyramid volume = ($\sqrt{2}$ (Max pyramid side * Max pyramid side * Max pyramid side))/6
After calculating the pyramid cube side length and max pyramid volume the view is then updated with a 3D representation of this cube and these values.

Triangular Pyramid
The volume is maximized by making it a regular rectangular pyramid. Based on the given length of the wood the maximum side of the pyramid is calculated in the model using the below formula

Max pyramid side = length of the wood / 8

The volume of this maximum possible pyramid is then calculated using the formula
Max pyramid volume = (Max pyramid side * Max pyramid side * Max pyramid side) / (6 * $\sqrt{2}$)
After calculating the pyramid cube side length and max pyramid volume the view is then updated with a 3D representation of this cube and these values.

5. INPUT VALIDATION

There are three basic validations implemented:

- Required: The length and the metric are required fields. The user cannot proceed further without providing/selecting value for these.
- Non-negative: The input length cannot be negative.

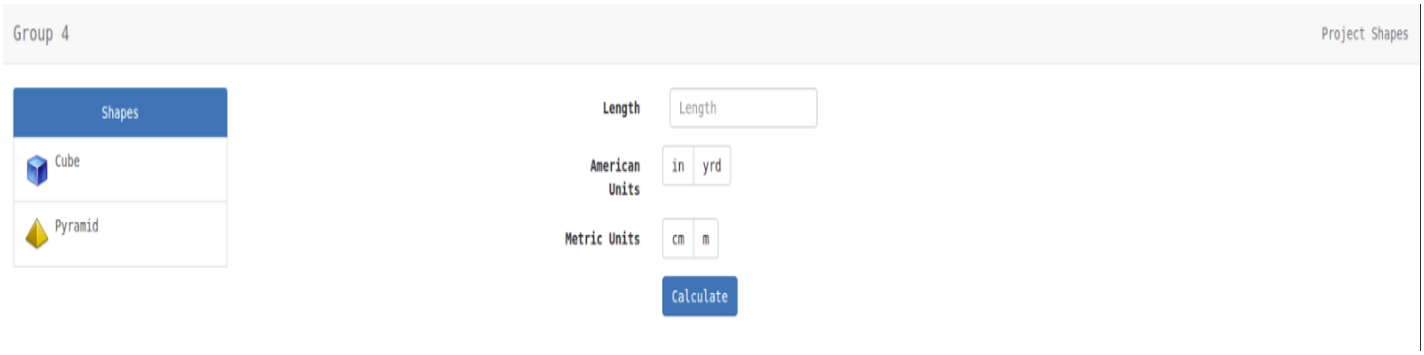
6. HUMAN INTERFACE DESIGN

6.1 Overview of User Interface

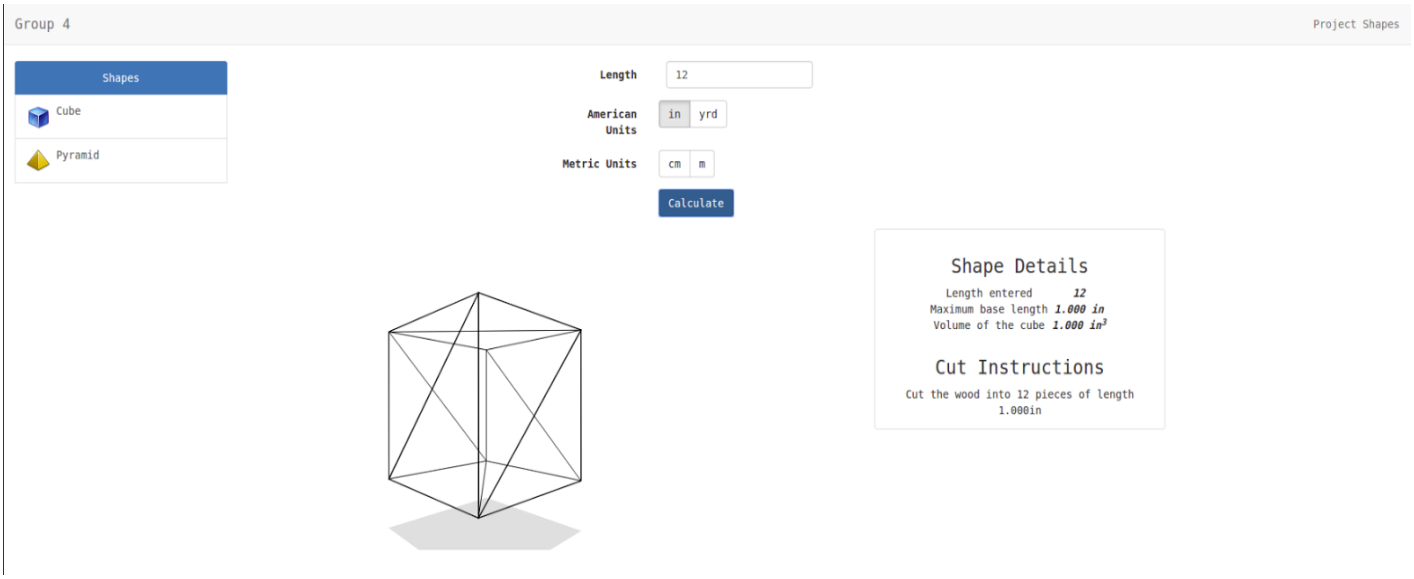
The user will be able to select the shape he/she wants. Then he/she can enter the length of the wood and select units such as centimeters, meters (Metrics system) or yards, inches (American system).
Based on the user input a corresponding visual representation of the shape is displayed along with basic dimensional details like maximum possible length and maximum possible volume. Also the number of pieces to cut from the wood to make the shape is displayed.

6.2 Screenshots

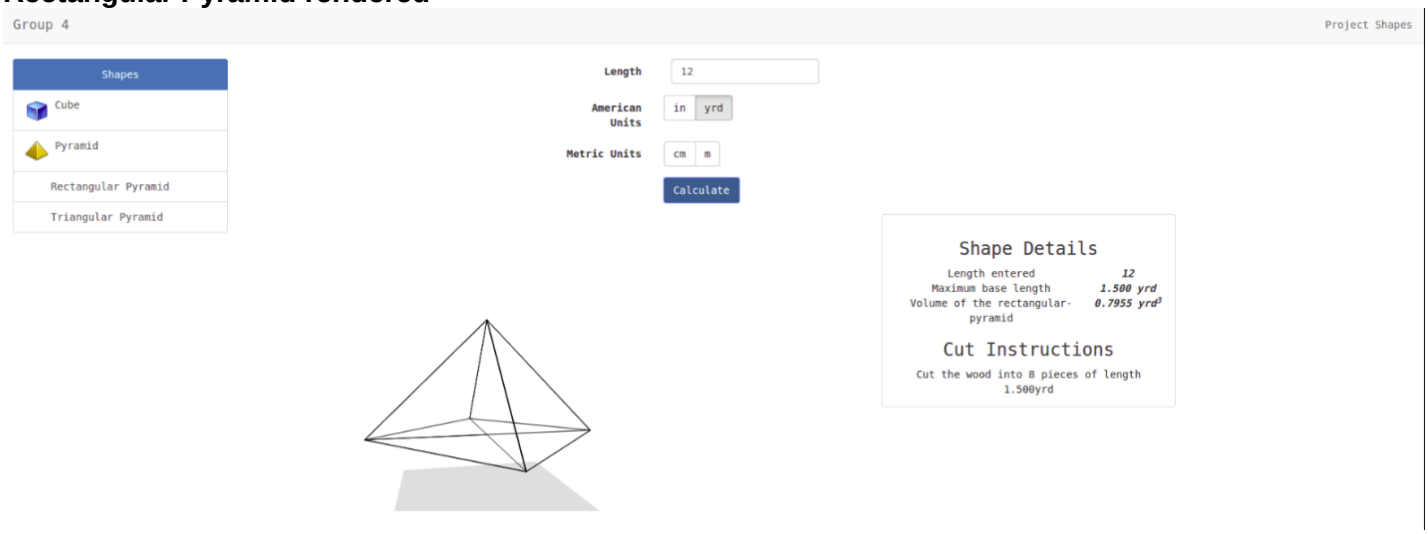
Home screen



Cube rendered



Rectangular Pyramid rendered



Triangular Pyramid rendered