Balloon Simulator

USER MANUAL

Acknowledgements

This project was designed with love and care by the following members of Team NoName

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Introduction

Thank you for downloading and using Balloon Simulator as part of your classroom's curriculum. We hope that you will find our software easy to use and reliable. This software was designed as part of a classroom project in CS4500 in the Fall of 2019 and released for public use by its developers.

What is Balloon Simulator?

Balloon Simulator is an open source project with the objective of providing a product to schools that is easily accessible and supports the advancement of S.T.E.M education in primary and secondary education. The goal of Balloon Simulator is to give students an insight into the physical properties of matter and physics by simulating a balloon filled with helium, whose properties can be tweaked and recorded to look for relationships between various properties of geometric shapes and physical forces.

How do I get started?

Getting started with balloon simulator is easy. Simply download one of our precompiled packages, extract it, and run the BalloonSim application.

Mac/Windows support

We offer support for Mac and Windows systems you can find under the builds folder.

Windows: Builds/Windows/ here you can choose you grade level package and download it. From there you unzip the package and run BalloonSim.exe

Mac: Builds/Mac/ here you can choose your grade level package and download it. From there unzip the package and run BalloonSim.app

To exit, simply hit the "esc" key on the top left of your keyboard.

Balloon simulator comes preconfigured for various grade levels. These are as follow:

K – 2

- Color wheel that adjusts balloon color
- Radius slider that adjusts the balloon's radius when adjusted

3 – 5

- Everything from K – 2 EXCEPT color wheel PLUS
- Data boxes which display the metrics about the balloon

6 – 8

- Everything from 3 – 5 PLUS
- Graphing functions that allow plotting points on a graph
- Wind Slider which allows an additional force to be applied to the balloon

What if I want to customize what is available/visible?

Go to the location where you downloaded this package, go to the folder named BalloonSim_Data, then go to the folder named Config. Inside, there is a file named config.json. Inside, you can adjust which elements will be accessible to the users. Simply adjust the values inside to your desired values. Refer to configuration information for details about each value.

Full Windows Path:
%path_to_downloaded_package_folder%/BalloonSim_Data/Config/config.json

Full Mac Path:
%path_to_downloaded_package_folder%/Contents/Config/config.json

Operation Manual

In this section, there will be detailed information about each user-accessible component of this package.

Section 1: User Interface elements

Section 1.1: Color Wheel

The color wheel allows the user to drag their mouse across the color palate and immediately apply the color under their cursor to the balloon. This feature is generally aimed at younger students in the K-2 category.

Section 1.2: Radius / Wind Slider Switch Box

The Radius and Wind Slider Switch Box appears at the top right corner of the display. If only the wind slider is available or only the radius slider is available, this box will not appear. This switch box will allow the user to switch between seeing the radius slider and the wind slider respectively. The wind speed is in m/s.

Section 1.3: Radius Slider and Buttons

Section 1.3.1 Radius Slider

The radius slider is designed to change the radius of by moving the slider, move it up to increase the radius and down to decrease the radius. The slider displays the maximum radius value in meters at the top of the slider and the minimum value at the bottom of the slider. The current value the radius slider is at is displayed at the bottom box where it dynamically changes based on the sliders position. Refer to Radius Configuration for more information about the default values provided.

Section 1.3.2 Inflate and Deflate Buttons

The radius panel provides the user inflate and deflate buttons that will change the value of the balloon radius based on the provided default values in the configuration file. Refer to Radius Button Configuration for more information about these values. The buttons are provided for specific incremental increase or decrease of the radius in the situation of data change relative to exact radius changes.

Section 1.4: Data Box

The Data Box displays properties of the balloon, such as its radius, surface area, volume, and upwards force it can exert with the current amount of helium that is present inside of it. This value does NOT include the side wind forces that are applied to the balloon.

- Radius is in METERS
- Surface Area is in METERS SQUARED
- Volume is in METERS CUBED
- Force is in NEWTON METERS (only includes vertical force, I.E. Force exerted by helium)

Section 1.5: Wind Slider

The wind slider is used to adjust the amount of wind force applied to the balloon horizontally (right to left). This force is added to the total force exerted upon the weight. Move the slider up to increase the wind speed and move it down to decrease the wind speed. The currently selected wind speed value will be reflected on the bottom part of the wind speed panel.

Section 1.6: Record/Graph/Export Module

The graph section will appear on the bottom left side of the display and has the following components:

1.6.1 Magnify Button

The magnify button opens the magnify UI element which allows a closer look at the graph, export of recorded data, and selection of graph axis values.

1.6.2 Graph

The main purpose of this module is to allow the user to graphically represent different values that they have recorded using the record button on the bottom left of the screen. Values that have been recorded can be viewed using the graph. In addition, the graph can be exported to an image.

1.6.3 Record Button

The record button takes a snapshot of the current values that are in the data box, the radius and other internal values. These values can be represented graphically on the graph module or be exported as a .csv.

Configuration Information

In this section, there will be information provided on each value of the configuration file. The configuration file can be located at:

Full Windows Path:
%path_to_downloaded_package_folder%/BalloonSim_Data/Config/config.json

Full Mac Path:
%path_to_downloaded_package_folder%/Contents/Config/config.json

Section 2: User Interface Elements Configuration

Section 1.1: Color Area Configuration

"colorWheel" Possible Values:

true - Enables the color area

false - Disables the color area

The configuration file contains values that reference the color wheel option to change the color of the balloon. The *colorWheel* value is set to true by default for the kindergarten – second simulation configuration. All other configurations have a default of false, turning the feature off.

Section 1.2: Radius Slider and Buttons Configuration

The configuration file contains values that reference the radius sliders properties named *minRadius*, *maxRadius*, and *radiusSlider*. Starting with the *radiusSlider*, the value can be true or false. A true value will provide the radius slider UI in the simulation and is set to true for every configuration. A false value will remove the radius slider from the UI and disable any change in radius of the balloon from the slider. The *minRadius* value is set to a minimum of 50 meters for a realistic visual when comparing the balloon to the rope. The *minRadius* value can be changed to anything greater than 50 and less than 400 with regard that the *minRadius* value is less than the *maxRadius* value. The *maxRadius* value has similar constrains, the *maxRadius* can be anywhere greater than 50 and less than 400 with regard that the *maxRadius* is greater than the *minRadius*. In the case that the *minRadius* value is greater than the *maxRadius* value or, the *maxRadius* value is less than the *minRadius* value, the default values will override the changes and set *minRadius* to 50 and *maxRadius* to 400. The UI also provides inflate and deflate buttons for incremental increase of the balloon radius. A false value will disable this feature.

Section 1.2.1 Radius Slider Configuration

"radiusSlider" Possible Values:

true - Enables the radius slider

false - Disables the radius slider

Details:

When *radiusSlider* is set to false it will disable the radius slider UI element but, allow for you to still change the balloon radius by using the inflate and deflate buttons. If the InflateDeflateButton and radiusSlider properties are set to false, the switch box to switch between changing the radius and changing the wind will be disabled and only the wind slider will be available for user. This feature is by default set to true for all configurations of the simulation and values are in meters.

"minRadius" Possible Values:

Whole number values 50 – 399

Constraint:

Must be less than maxRadius

Default value:

minRadius: 50

Details:

Changes the minimum radius of the balloon in meters.

"maxRadius" Possible Values:

Whole number values 51 – 400

Constraint:

Must be greater than minRadius

Default value:

maxRadius: 400

Details:

Changes the maximum radius of the balloon in meters.

Section 1.2.2 Inflate and Deflate Buttons Configuration

"inflateDeflateButton" Possible Values:

true - Enables the inflate / deflate buttons

false - Disables the inflate / deflate buttons

Details:

Disabling the *inflateDeflateButton* property will cause the inflate and deflate buttons to be removed from the UI. The radius slider will still be available for the user to change the radius of the balloon. Giving the *InflateDeflateButton* property a value of false and the *radiusSlider* property a value of false will cause the switch box UI element for changing between the wind and radius sliders to disappear and only the wind slider will be available for the user. This feature is by default set to true for all configurations and values are in meters.

"inflateIncrement" Possible Values:

Whole number

Constraint:

>= 1 AND < maxRadius

Default value: 10

"inflateIncrement" Possible Values:

Whole number

Constraint:

>= 1 AND < maxRadius

Default value: 10

Details:

The configuration file contains the values *inflateIncrement* and *deflateIncrement*, which refer to the change in meters of the radius. Each time either button is pressed it will change the value of the radius to the set values of *inflateIncrement* or *deflateIncrement*. The default value provided is 10 which corresponds to 10 meters. These values can be customized however the user likes with a few constraints. The value of *inflateIncrement* and *deflateIncrement* must be greater equal to 1 and less than the *maxRadius* value.

Section 1.3: Data Box Configuration

"dataBox" Possible Values:

true - Enables the data box

false - Disables the data box

Details:

The databox feature provides real time data to the user from changes in the physics of the balloon through use of the sliders or buttons. By default, the *dataBox* property is set to false for kindergarten – second grade configuration and set to true for the rest of the configurations.

Section 1.4: Wind Slider Configuration

“windSlider” Possible Values:

true - Enables the wind slider

false - Disables the wind slider

Details:

The wind slider applies wind to the balloon changing the data in the databox dynamically and providing a visual for the wind. Giving the *windSlider* a false value will cause the wind slider to be removed from the user’s UI and the switch box feature for switching between the radius slider and wind slider will be removed as well. Only the radius slider, inflate button, and deflate button will be provided they all have a value of true. By default, the *windSlider* feature is set to true for only the sixth – eighth grade configuration.

“minWindSpeed” Possible Values:

Whole number values 0 – 4

Constraint:

Must be less than maxWindSpeed

Default value: 1

Details:

Increases minimum wind speed of balloon in meters/second

“maxWindSpeed” Possible Values:

Whole number values 1 – 5

Constraint:

Must be greater than minWindSpeed

Default value: 5

Details:

Increases maximum wind speed in meters/second

Section 1.5: Graph Configuration

“graph” Possible Values:

true - Enables the data collection/display area

false - Disables the data collection/display area

Details:

The graph provides real time recording for users to track the current physics data at the moment of pressing the record button in a graphical format. Providing a true value for *graph* will show the graph in the bottom right corner of the users UI. Disabling the graph will remove the graph from the users UI. By default, the graph is set to true for only the sixth – eighth grade configurations.

“recordButton” Possible Values:

true - Enables the data collection button

false - Disables the data collection button

Constraint:

graph must be true to be visible

Details:

The record button allows users to record real time physics data of the balloon on the graph feature. This features value of true is dependent on the graph property also being true. Disabling this feature will cause the graph to be disabled and both features removed from the UI. If this feature is enabled while the graph is disabled, the *recordButton* will be relabeled from record to export and the data from pressing export will be exported to a CSV (comma separated values) file. If the graph and *recordButton* are both set to true, the real time data will be provided in a visual graph that can be magnified and exported to a CSV. By default, the graph and record button features are set to true for only the sixth – eighth grade configurations.

“csvExportPath” Possible Values:

Export path string starting at the base of the program’s installation stored in a folder named Exports.

“imageExportPath” Possible Values:

Export path string starting at the base of the program’s installation stored in a folder named Exports.