Parabolic Motion Modeling and Analysis in High School Students Using the GUI Matlab Application

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Abstract: The purpose of making this visualization of parabolic motion , because it is to make it easier for students to learn about the concept of parabolic motion. Using matlab simulations, students are also trained to learn using the scientific method. The use of simulation with matlab in learning, the role of the teacher is very important to guide students to do simulations appropriately. MATLAB is one of the supporting media for software-based physics learning called Matlab (matrix laboratory) can be used by teachers in schools on parabolic motion materials.

Keywords: Parabolic Motion. Matlab GUI, Simulation

1. Introduction

Learning physics at the high school level to college the problem of parabolic motion is a very important point. Parabolic motion is a motion whose trajectory is in the form of a parabola. Parabolic motion combines two axes, namely horizonal which is GLB (Regular Straight Motion) and on the vertical axis is GLBB (Regular Changing Straight Motion) which is also called two-dimensional parabolic motion.

Parabolic motion has an initial speed. But thus not all movements have an initial speed. Parabolic motion has components, namely the distance and height of the object. This parabolic motion is often applied in sports and other fields. In the field of sports parabolic motion requires very accurate calculations. So that the angle and initial speed when throwing a bullet will affect the shape of the trajectory. Along with this, it is sometimes difficult for students to calculate the speed at which the bullet falls in place. From this problem can be solved by using Matlab.

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According to Fahrun, et al (2022) MATLAB or stands for *Matrix Laboratory* is a programming application that uses a matrix-based language so that it is generally used to analyze data, create algorithms, and create modeling. Matlab also produces interesting graphics and stimulation. Inside Matlab there are tools for creating *graphic user interfaces* (GUI). This matlab GUI has the ability to create excellent and attractive graphical displays, resulting from a relatively small GUI file size. Matlab is also an application that is often used to help science learning in schools, especially in physics learning.

In this case, the research is designed modeling based on the matlab program. The parabolic motion equation that already exists as a determinant of distance and maximum height is shown in theory and application of the Matlab GUI.

2. Research Methods

The research that has been carried out there are several stages including, vector analysis of motion equations against parabolic components (horizontal and vertical, Matlab GUI design, trials and program analysis.

To run the GUI (*graphic user interface*) matlab will find an editor window containing syntax (*coding* data). At this stage, programming is carried out by writing commands on the components of the graphic icon through the M-file. Then run the matlab GUI program that has been created by clicking runon the menu bar.

As for the commands entered into the program listings are the equations of parabolic motion based on (Giancolli, 2001):

a. At the highest point it means the maximum y position, then the velocity on the y axis (= 0), so the time it takes to reach the highest point is: V_{ty}

$$t_y = \frac{V_o.\sin\theta}{a}$$

b. While its maximum height (y_{max}) is:

$$y_{maks} = \frac{V_0{}^2 . \sin^2\theta}{2\,g}$$

c. At the furthest point from the starting point meaning the maximum x position, then the time it takes to reach the farthest point is:

$$t_x = \frac{2 . V_0 .\sin\theta}{g}$$

d. While its farthest position (X_{max})is:

$$X_{maks} = \frac{V_0{}^2 . \sin^2\theta}{g}$$

3. Results and Discussion

The results obtained from the study are products in the form of visulaization in parabolic motion.
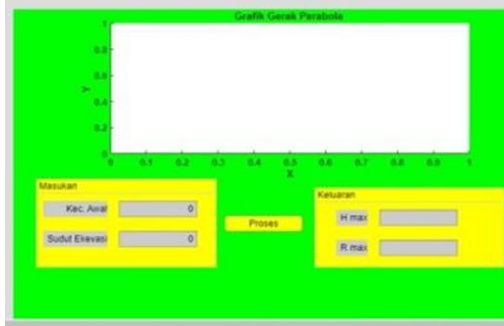

Figure 1. Initial View of the Matlab Program

At the top there is an inscription 'Parabolic Motion Graph' then on the Input box, there are 'Angle' and 'Speed' sections. Where in the initial angle and speed can be entered the desired value and the program can be run, shown in Figure 1. Then after the program is run it will produce a graph as in Figure 2.
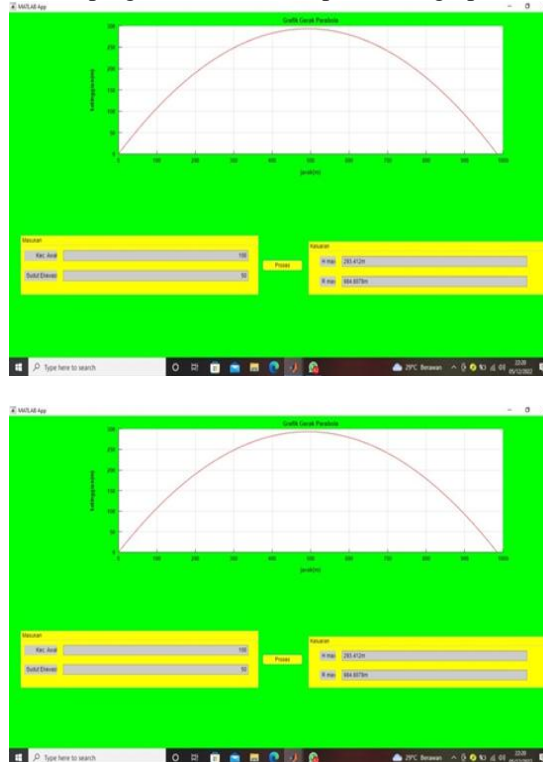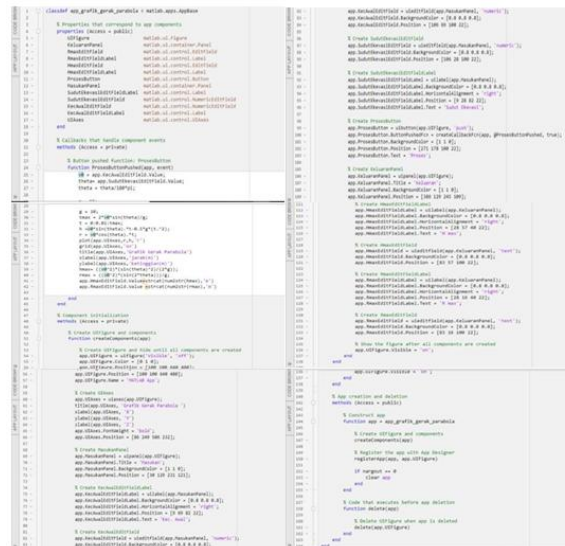

Figure 2. Resulting graph view

Based on the results of the initial angle and velocity input, the visualization tool for parabolic motion material can be used properly. This can be seen from the process of entering values to run the program and no *error* statement on the *Matlab comman windows*. As can be seen in Figure 3.

Figure 3. Matlab Coding Display

In Figure 3 To facilitate understanding in solving parabolic motion equations. Figure 3 Also is a piece of data coding used to run a simulated parabolic motion. In matlab, it can automatically create an M-File containing syntax with function variables that are in line with the GUI figure.

Starting from the simulation results, it can be concluded that, the Matlab GUI can be used for student learning media in analyzing parabolic motion graphics.

4. Conclusion
To visually demonstrate the motion of the parabola assisted Matlab was completed in a program listing with the same results. So that it can be used to support the learning of parabolic motion material.

But in this case, the perga media must be further researched in order to find out the improvement of this media understanding when conducting learning in schools. In making this program, of course, there are many shortcomings and mistakes so that further research can be refined, made with a more attractive appearance. So that this learning media is not only to help mathematical calculations.

5. References
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