# Evaluation, Simulation and Visualization Parabolic Motion Using Matlab as Physics Media Learning

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*Abstract*— **Kinetic is a physics branch that studies the motion. Parabolic motion is one of the subject in High School physics. All this time the media to learn parabolic motion can not be proven as a visual and mathematical angle in relation to the height and the farthest distance. Parabolic motion subject will be a lot more meaningfull if it were practiced, so the student can see the the value in parabolic motion. That is why there is need a development to construct an application that can give evaluation, simulation, and visualitation to the parabolic motion. The research method that were used is a reseatch and development ( R&D ). The research procedure refers to ADDIE's step, but the executed steps are analytic, design, development and heavy machinery test. The parabolic counting apps were constructed using the matlab version R2020a. The app interface were design with the tools GUI (Graphical user interface) in the matlab. From the result of an apps parabolic motion counter were achieved that the parabolic motion counting apps is working well and correct, from the simulation results, shown graphic and the buttons on the menu.So the apps to count the parabolic motion can be used as a learning media in High School physic.**

*Keywords— physics learning, matrix laboratory, GUI, virtual laboratory*

## I. Introduction

Physics is one of the subject that is sure to learn about the nature's order. One of the physics branch is kinetic. Kinetic is a physics branch that studies about things motion without taking account of the force that cause the things to move. Physics in general is learn with the simple physic practice tools that the measurement is still manually operated. In the physics practice, the ease and simplicity in doing the task is one of the demand that needs to pay an attention because not only that it can boost the practice progress it also optimized the practice time [1],[2].

One of the physics theory that the phenomenon can be observed in daily life is parabolic motion. Parabolic motion is one of subject that studied in High School physics. In High School physics learning the teacher found the difficulty in giving the right learning media. The right learning media that were said is the media that can fulfill the students need towards the learning media. All this time the learning media for parabolic motion is a simulated parabolic motion videos, simple practice using water and protractor. This can not prove visually and mathematical the angle relation with height and farthest distance. The parabolic motion theory will be a lot more meaning full when practiced, student can see the difference value in parabolic motion. With that the student were able to understand it

better the relation difference value in parabolic motion and the learning process should not taken a lot of time.

The learning progress must have been made as interesting as possible and as fun as possible [1]. Even we are often hear "Playing while learning" not learning while learning. Unfortunately this stays as a slogan without any realization. In fact the learning progress always striking with a boredom that many student can not focus during the progress. The theory served with a simulation method helps the student to visualize so the student can easily understand the learned theory[3], [4]. According to the first needed analytic result 92% were choose to use the media that can give simulation, visualization, and evaluation in the parabolic motion.

One of the media that is effective in learning the parabolic motion is using a matlab. Matlab is a software that can do mathematical calculation, data analytic, expanding the algorithm, doing simulation and modeling, and also presented it in a chart form [1]. Matlab is also a short from Matrix Laboratory. Matlab were used for technical computing and scientific. Because of it's easy to use, integrated computation and visualization, makes matlab can be used as a calculator and a programing language.

Matlab has a tool called GUI. GUIDE or GUI is Graphical User Interface (GUI) that were build with graphic object such as button, text square, slider, menu, etc [5]. GUI is easily operated because we only need to input the value that were asked without knowing the program. By using the GUI the researcher has made many physics calculator and in many subject. Matlab application in the form of a physics calculator can be very helpful in a mechanical experiment [6].

Calculation tools using matlab has been developed by [7] according to analysis numeric research using MATLAB this were done to ease the calculation in the usual differential equation in the mathematical swing that if were done using analytical method takes a long time. [3] has developed physics calculation tools in the vertical motion subject based on Matlab can works well in counting about vertical motion. [8] his research result that is MATLAB program will ease the counting in the first derivative function as a numerical and visualize it in chart, for any purposes and how many accuracy that were needed.

According to the foregone result there has been a lot of calculation apps that were developed by the help of

MATLAB software. So to say to ease the student in understanding parabolic motion, the researcher developed a counting parabolic motion apps helped by matlab to ease the student in physics counting. The purpose of this study is to provide understanding to students in learning physics, especially the material for parabolic motion by using a calculation application in the form of GUI simulation Matlab software.This counting apps give simulation, visualization, and evaluation in the parabolic motion subject.

## II. RESEARCH METHOD

Research method that were used is research and development (R&D). The Object in this research is a counting parabolic motion app [9]. The development model used in this study is the ADDIE development model. ADDIE stands for Analysis, Design, Development, Implementation and Evaluation. This model consists of five steps, namely: 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. This model can be used for various forms of product development such as textbooks, learning modules, learning videos, multimedia and so on. But in this research the ADDIE steps were not done completely . The steps taken are analytics, design, development, and tools testing. The research procedure refers to ADDIE steps as show in figure.1
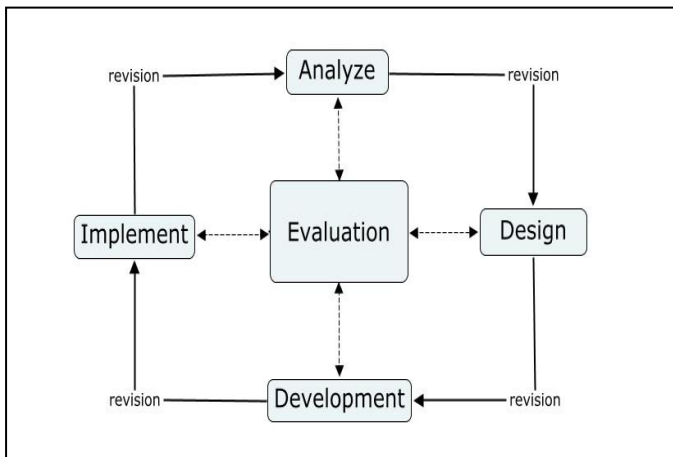


Fig. 1.   ADDIE In Model [9]

In the analytic steps were done study literature about the media that wanted to be developed. Study literature are in relation to the Matlab software, parabolic motion and physic tools calculation [2]. The design steps were done by creating calculation and GUI interface as a learning media that can shown a simulation, evaluation, and parabolic motion visualization. The menu interface that were design will be made interesting dan ease the student in the operation. The Matlab app that were used is a R2020a version.

The process of these models is generally linear from one phase to the next. [10] stated that, in multimedia software design, the process that occurs is not as easy as the original ADDIE model process. According to them, the ADDIE model was developed independently integrated with the principles of multimedia learning design.

Interactive Physics Development for Evaluation, Simulation and Visualization of Parabolic Motion is a combination of directed design methodology and software life cycle. The ADDIE model has been studied and used as a basis for modeling courseware development for physics

movement for high school. The ADDIE model is still used by many people researcher. In addition, researchers also included a Rapid Prototyping phase in addition to ADDIE model development phase.

Based on Enhanced ADDIE Model, this systematic process is cyclical and iterative, and the initial process of this model is analysis phase, followed by a design, development, implementation phase (with elements focused on formative assessment). After the product according to the needs has been made, then a summative evaluation will be carried out carried out to validate the effectiveness of the product.

Development steps were begin by inputting program language/coding about parabolic motion and coding the button that will be used. In the final step, were done a media test by inputting the angle and speed that variated and then compared to manual calculation. If the result is not different, that means the coding is works well as function. In the chart interface will shown the angle and the corresponding chart input.

## III. RESULT AND DISCUSSION

The making of media learning physics subject in the parabolic motion based on matlab is a new innovation in the learning media. Learning media that is generated can help in the evaluation, simulation, and visualization on the parabolic motion theory. The goal of the making of this media is so that the student can understand it better and helps in completing task in the parabolic motion theory. The media that is developed such as digital calculator that can shown a graphical chart of parabolic motion with the angle and speed that were inputted by the student. The app calculation design interface can be seen on figure 2.
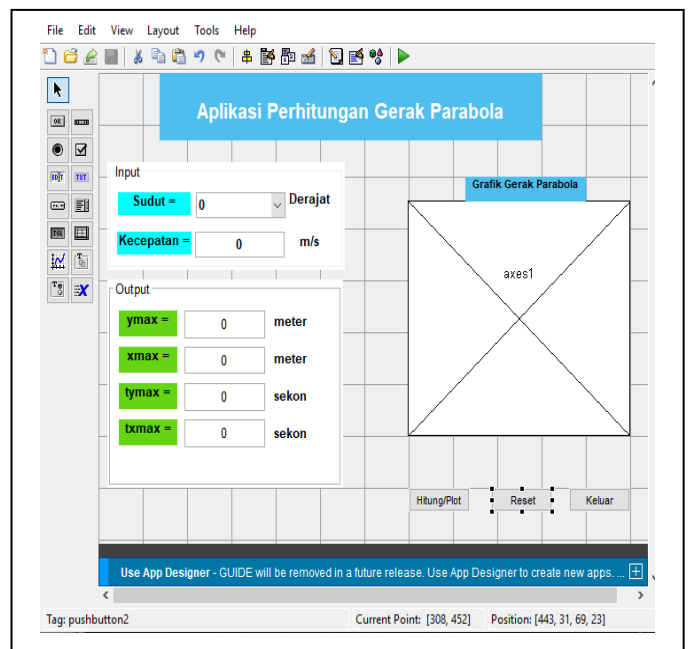


Fig. 2.   Parabolic motion calculating application display design

The initial stage of application development is to analyze the coding and parabolic motion formulas that will be entered into Matlab. The purpose of this analysis is so that when the application is run, there are no errors that can be fatal. If there is an error, the parabolic motion calculation

application cannot be used. The possible error that appears is that the calculated results are not displayed, the graph is not displayed, it could even be that the results of the calculations are wrong. Therefore it is important to compile a flowchart or design formula that will be used. After determining the formula to be used, the second stage in the development of the parabolic motion calculation application is to create a template or display for the parabolic motion calculation application. This template will show the output of the input or numbers that we enter in the angle and speed column.

This calculation app design interface is using a GUI on matlab. Tools that were used in the counting/plot menu, reset and exit using the push bottom that is connected with the coding by inspector properties. For the quantity menu in the parabolic motion using edit text and the quantity value using static text. Counting result that were inputted will shown a parabolic motion chart. This chart were design using tool axes and in the coding we input the farthest plot point and highest point. Result in the early interface design app after run can be seen on the figure 3.
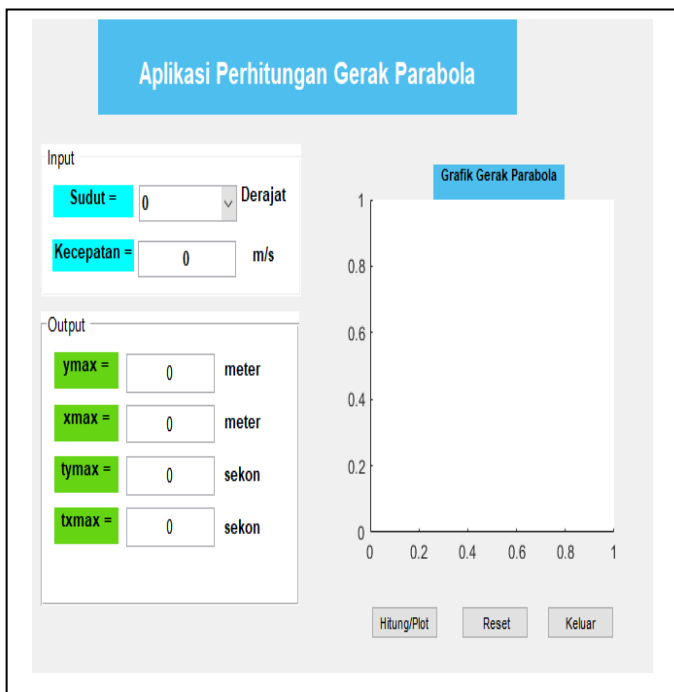


Fig. 3.   Parabolic motion calculating application display design

Figure 3. Is a GUI interface from matlab that is already developed. This media is developed with the filling panel and result panel. In the filling panel the student can fill their own angle and speed of the desired object. In the result panel will be resulted with output of farthest distance (xmax), highest point (ymax), the time needed to reach the highest point (tymax), and farthest point (txmax) according to the inputted angle and speed. The filling menu were made using the toolbox that is present in the matlab and connected with coding. There exist 3 buttons in this counting app that were made using the tools pushbutton. In the pushbutton 1 switch the string were replaced to counting/plot, pushbutton 2 were replaced with reset and pushbutton 3 were replaced to exit. Coding in the counting/plot menu button can be seen on the figure 4.
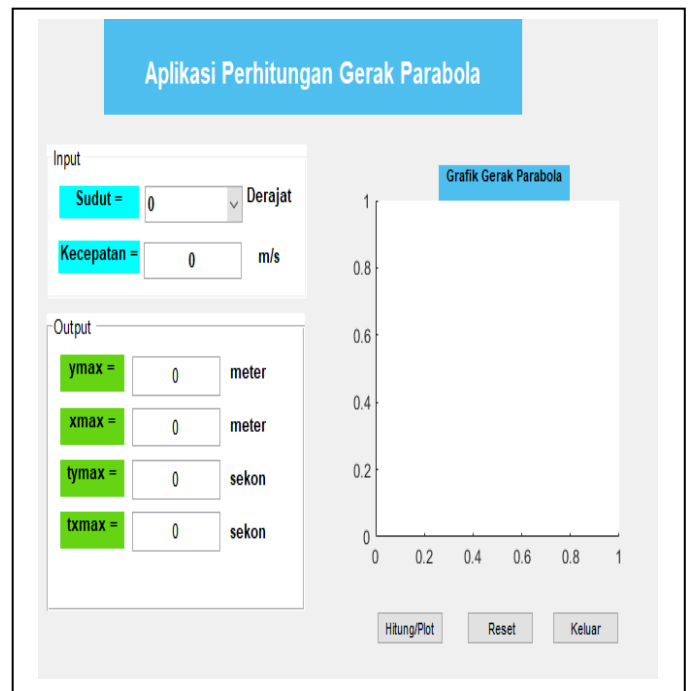


Fig. 4.   Coding Count/Plot Button Program

The counting/plot button function as to count and shown the chart from the data result that were inputted. In the beginning of coding were written the input first, like the object angle taken from pop up menu 1 that is the angle that we already constructed in the first place. The speed were taken from static text edit 1, and then proceed with the coding parabolic motion formula. To do a recalculation can be done by pressing reset button. Coding on the reset button can be seen on Figure 5.

```
% --- Executes on button press in pushbutton2.
function pushbutton2_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set (handles.edit1,'string',0);
set (handles.edit6,'string',0);
set (handles.edit7,'string',0);
set (handles.edit8,'string',0);
set (handles.edit9,'string',0);
set (handles,popupmenu1,'value',0);
xmax=0;
ymax=0;
axes (handles.axes1);
plot (xmax,ymax);
```

Fig. 5.  Coding Reset Button Program

The reset button is function as to return to the home interface before being used. When reset button is pressed the number that is shown on the menu will return to 0. In the coding input, the string value is 0 for every menu and no chart were to be plotted. To shown the counting result in the designed menu then the coding that were going to be used can be seen on the figure 6.

```
%rumus untuk memasukan hasil ke edit text
set(handles.edit6,'string',ymax);
set (handles.edit7,'string',xmax);
set (handles.edit8,'string',tymax);
set (handles.edit9,'string',txmax);
%rumus untuk memasukan ke grafik
voybenda=kecepatan*sin(sudutbenda1*pi/180);
voxbenda=kecepatan*cos(sudutbenda1*pi/180);
tbenda=0:txmax/100:txmax;
ybenda=(voybenda*tbenda)-(0.5*10*(tbenda.^2));
xbenda=voxbenda*tbenda;
axes (handles.axes1);
plot (xbenda,ybenda);
xlabel ('Jarak (m)');
ylabel ('Tinggi (m)');

legend (['sudut' num2str(sudutbenda1)

'Gerak Parabola Oleh Sharmila'],'Location','northwest');
```

Fig. 6.  Coding Parabolic Motion Program

After the angle value and speed were input then the count/plot button will process the calculation and the result will be entered to the quantity menu that is determined. The formula to entered the result to edit text that is by changing the strings to the quantity value that were input on the coding count/plot button that is ymax, xmax, tymax, and txmax. Whereas the formula to include the chart were input the parabolic motion formula then in the highest plot with the farthest distance for every time unit based on it's speed.

After the coding is arranged properly without any errors, the application of physics calculations on parabolic motion can be used. How to use it, the user inputs the value and then clicks the calculate/plot button, then the results of the calculation will immediately come out without any errors. When the calculate/plot button is clicked, the graph of the relationship between the highest point and the furthest distance will automatically be displayed in meters. If the user wants to repeat or want to input a different value then the user must click the reset button to return to the initial settings. The results of this calculation if calculated manually the results will be the same.

On the exit button is written the coding in order to exit from the parabolic motion count app and return to the command windows interface on matlab. The parabolic motion calculation app is shown simulation, evaluation, and visualization on the parabolic motion. Every button has it's

own function and in the input menu we can organize the number as what we want the result to find. The output result from the calculation app can be seen on figure 7.
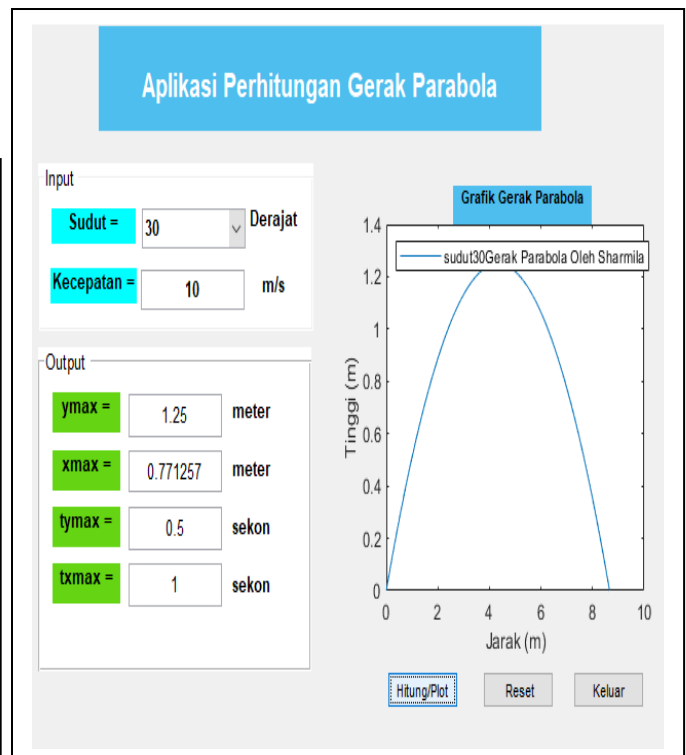


Fig. 7.  Parabolic Motion Calculating Application Output

The first step in using the parabolic motion calculation app is by inputting the value that is angle and initial speed, then click on the counting/plot menu to see the counting result and the chart that were generated. From the counting and chart result, this app can count/plot correctly. So that the calculation application can be used as a media evaluation, simulation, and visualization in learning the parabolic motion.

The application of a GUI in a physics calculation application that displays simulations, evaluations and visualizations using matlab software can be applied to parabolic motion material. In the use of matlab software with the gui method, it can display the results of calculations and graphs of parabolic motion material. This calculation application is expected to increase students' interest in learning physics. Students can compare the results of manual calculations with this application and can observe graphs on parabolic motion.

## IV. CONCLUSION

The physics calculation application in the parabolic motion theory based on matlab can work well and correct in counting and chart plot. The buttons works just as the written commands code. The physics calculation application on the parabolic motion theory based on matlab can be used as a physics media learning. Suggestion for the next research is by doing validity test, effectivity and practicality on the calculation application of parabolic motion.

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