Graphic User Interface (GUI) Matlab for Making Media Teaching Media Straight Motion Physics

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Abstract: The purpose of this study was to analize he use of GUI Matlab as a medium for learning physics for students at the SMP/MTs and SMA/SMK/MA levels through literature study. The method used is a literature study and development research with a 4D approach (define, design, develop, and dessimenate), but this research has only reached the development stage. The results obtained are that a physics calculator has been made for GLB and GLBB materials that can be used in calculating questions with the calculation results in accordance with manual calculations. In addition, based on the existing literature, the Matlab GUI can be used as a learning medium for straight motion physics subjects.

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Introduction

Matlab is a commercial mathematical software produced by Math Works Inc. This software can be used to develop mathematical algorithms, numerical methods, data visualization, data analysis, simulation and modeling, graphics for science and engineering, application development using a GUI (Liu & Gao, 2012). In addition, applications and external programming languages, such as Java, C, NET and Microsoft Excel can be integrated with Matlab (Widiyatun, 2021). Although Matlab is a high-level programming language for science and engineering, it is very user-friendly (Sen & Shaykhian, 2009). The use of the Matlab GUI to make calculators in education has been widely used, one of which is to make physics calculators.

Straight motion is one of the materials in physics subjects. Straight motion is divided into two, namely uniform straight motion and uniform skinny motion. The use of Matlab as a learning medium has been carried out for various levels of education and learning materials. With Matlab in Physics learning, it makes students able to understand the physics equations that are brought in the Matlab programming language, namely by writing the equations in *Coding language*. Research conducted at SMP Negeri 5 Kopang, Central Lombok, on grade VII students regarding the use of Matlab learning media showed that there was an influence on student learning outcomes (Puji & Handayani, 2020). There has also been research on digital literacy using MATLAB for junior high school students on set material (Syaharuddin et al., 2017). From the results of the study, it was found that 80% of students could determine the members of the set and the empty set, and 100% of students could draw Venn diagrams.

In addition to some of the research above, research on the development of learning media has also been carried out using Matlab at SMK Telkom Makassar (Negara et al., 2018). The results of this study indicate that the learning media used meet the valid, practical and creative criteria. At the SMA/MA level, learning media have been developed using the

Matlab GUI for trigonometry material (Mulyawati et al., 2017). The media created consisted of procedures for using media, learning materials, practice questions and profiles. At the university level, this program has proven to be able to help students understand and master numerical methods course material (Negara et al., 2018).

The purpose of this study was to analyze several references regarding the application and use of GUI Matlab as a learning medium in Physics subjects for straight motion material at the SMP/MTs and SMA/SMK/MA levels. The learning media in question is the manufacture of a physics calculator. Physics calculators apart from being a learning medium, can also be used by students to be able to easily analyze physics experiments quickly and validly (Yosua et al., 2020). In addition to physics experiments, of course, it makes it easier to solve physics problems that use calculations that require complex equations quickly and precisely.

Research Method

The research method used in this research is literature study and development research from ADDIE with a 4D approach (define, design, develop, disseminate). However, for the research development stage this time, the media created has only reached the design and development stage, not yet reached the response stage from the user. For the next stage will be tested on the response from the user. The literature study in question is that researchers look for references and collect literacy related to research. Among them are previous studies using the Matlab GUI in the subject of motion physics and other studies related to the Matlab GUI. After doing a literature study, the researcher made a physics calculator with different materials, namely, uniformly straight motion (GLBB) and uniformly changing straight motion (GLBB). The next step is to determine the display design and create a *figure* from a Matlab-based calculator. After that the calculator design is made, the next step is coding or *listing the* command program in the matlab calculator. Coding is done by writing the equations of GLB and GLBB material in a programming language written in the Matlab program.

The last step is to test the Matlab calculator that has been made by clicking *Run.* The test is in the form of matching values with manual calculations, whether the values or results displayed in the calculator are the same as the manual calculations. If there are no errors or *errors* in making a Matlab-based physics calculator, the application can calculate the problem and produce *output* according to the desired command. But if there is an error in the Matlab-based physics calculator, an *error* sign will appear with red writing in the *command window* when we run the program. In this study, the Matlab program used is Matlab R2013a, a laptop specification used by *Windows* 10 with *an AMD Ryzen* 5 processor and 8 GB Ram.

Uniform Straight Motion (GLB) and Uniform Straight Motion (GLBB)

An object is said to be in uniform straight motion (GLB) if its path is a straight line and its velocity is constant (constant). Since the velocity is constant, it can be seen that the acceleration of the object is zero. The distance traveled by an object in uniform motion is defined as follows. An object is said to be in uniform straight motion (GLB) if its path is a straight line and its velocity is constant (constant). Since the velocity is constant, it can be seen that the acceleration of the object is zero. The distance traveled by an object in uniform motion is defined as follows.

$$s = vt \tag{1}$$

Information:
s = distance traveled by object (m);
v = object speed (m/s); and
t = time interval traveled by the object (s).
An object is said to be in uniform uniform motion (GLBB) if its trajectory is in a straight line and its velocity is always changing regularly. Because the velocity is always changing regularly, it can be seen that the acceleration of an object is always constant.

$$s = v_o t + 0{,}5a\, t^2 \qquad (2)$$
$$v_t = v_o + at \qquad (3)$$

Information:
s = distance traveled by object (m);
v$_o$ = initial velocity at time t_o (m/s);
v$_t$ = final velocity at time t_t (m/s);
t = time interval traveled by the object (s).

Results and Discussion
Some Literature on Physics Calculators on the Physics of Motion

Several articles have discussed physics calculators, for Physics subjects, including the first about quantities and units. The physics calculator is made with a choice menu, including length, mass, time, area temperature, volume (Alhidayatuddiniyah & ..., 2020). The second is material about kinematics. The physics calculators made include Uniform Motion (GLB) and Uniform Uniform Motion (GLBB). GLBB made with acceleration and deceleration. The calculation sought is the distance traveled from an object (Astuti & Alhidayatuddiniyah, 2020). In addition, a physics calculator for the material of vertical motion was also made which was designed by Agustinasari and Ria Asep Sumarni. Where in the calculator contains vertical upward motion, downward vertical motion, and free fall motion. The calculator made consists of three parts, namely GVB (Downward Vertical Motion), GJB (Free Falling Motion), and GVA (Upward Vertical Motion). Input variables for GVB include initial velocity, time, and acceleration due to gravity. The input variables for GJB are initial velocity, time, acceleration due to gravity, and initial altitude. The input variables for GVA are initial velocity, final velocity, and acceleration due to gravity. As for the output, for GVB and GJB are the object's height and final velocity, for GVA it's the object's height and time. The calculator can be used properly and correctly to solve case examples on vertical motion. (Agustinasari & Sumarni, 2021).

The Physics Calculator for Newton's force of matter was created by Okyranida. The calculator made can be used to calculate normal force, static friction, description of the state of objects (rest or motion), kinetic friction and acceleration of objects. The input variables for this calculator are the object's mass, force, static coefficient and kinetic coefficient. The interesting thing about this calculator is that when calculating the force < static friction, there is an indication that the object is at rest. However, if the force < static friction, then there is an indication that the object is moving. This calculator can be used properly with results as in manual calculations (Okyranida et al., 2021).

A physics calculator has also been made for calculations on the pulley system. By using the MATLAB GUI in this material, it is hoped that it can improve students' understanding for solving the pulley system (Nugraha, 2020). A physical calculator for work and energy was created by Sumarni. This calculator has been tested and obtained good results

from the respondents. In addition, the physics calculator created can also be used to assist in understanding the task in the form of a simulation.   (Sumarni et al., 2021).

Making a physics calculator for uniformly uniform motion (GLB) and uniformly changing linear motion (GLBB)

Making a physics calculator for GLB and GLBB material as shown in the image below, Figure 2. In the calculator it is used to calculate the final velocity value for a GLBB movement and the distance that can be traveled in a certain time interval. In addition, this physics calculator functions to determine the distance traveled in a GLB movement.
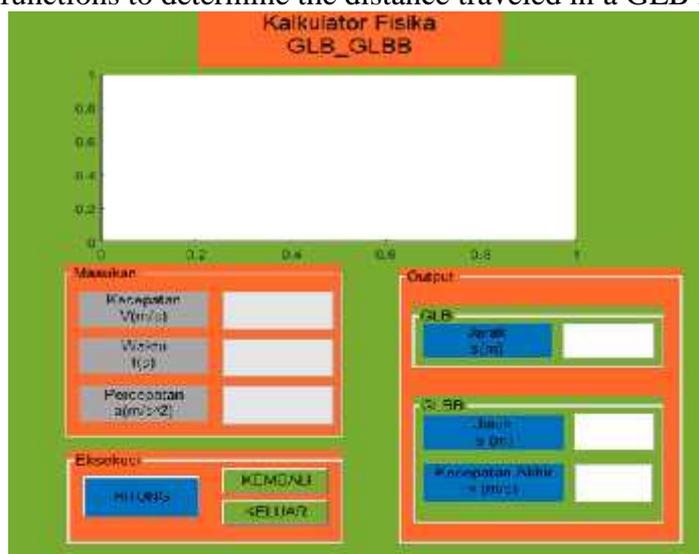
Figure 2. Display of a physics calculator to calculate the final velocity value for a GLBB movement and the distance that can be traveled in a certain time interval, and determine the distance traveled in a GLB movement.

The equation for calculating the variables in GLB and GLBB is written as follows:

$$s = vt \tag{1}$$
$$s = v_o t + 0{,}5a\, t^2 \tag{2}$$
$$v_t = v_o + at \tag{3}$$

The distance traveled in the GLB motion is calculated using equation (1). Meanwhile, the final distance and velocity values in glbb motion are calculated using equations (2) and (3). The list of programs used to calculate the distance in the GLB and the GLBB motion and the final speed of the GLBB motion from the physics calculator display above are as follows:

```
function pushbutton1 Callback(hObject, eventdate, handles)
% hObject     handle to pushbutton1 (see GCBO)
% eventdate   reserved - to be defined in a future version of MATLAB
% handles     structure with handles and user data (see GUIDATA)
%inputan
v=str2double(get(handles.edit1,'string'));
t=str2double(get(handles.edit2,'string'));
a=str2double(get(handles.edit3,'string'));

%persamaan
jarakGLB = v*t;
jarakGLBB = (v*t)+(0.5*a*(t^2));
kecepatanakhir = v + (a*t);

%Output
set(handles.edit4,'string',jarakGLD);
set(handles.edit5,'string',jarakGLBB);
set(handles.edit6,'string',kecepatanakhir);
```

An example of calculating the distance on the GLB, distance and speed on the GLBB from the physics calculator display above, as shown in Figure 3, below.
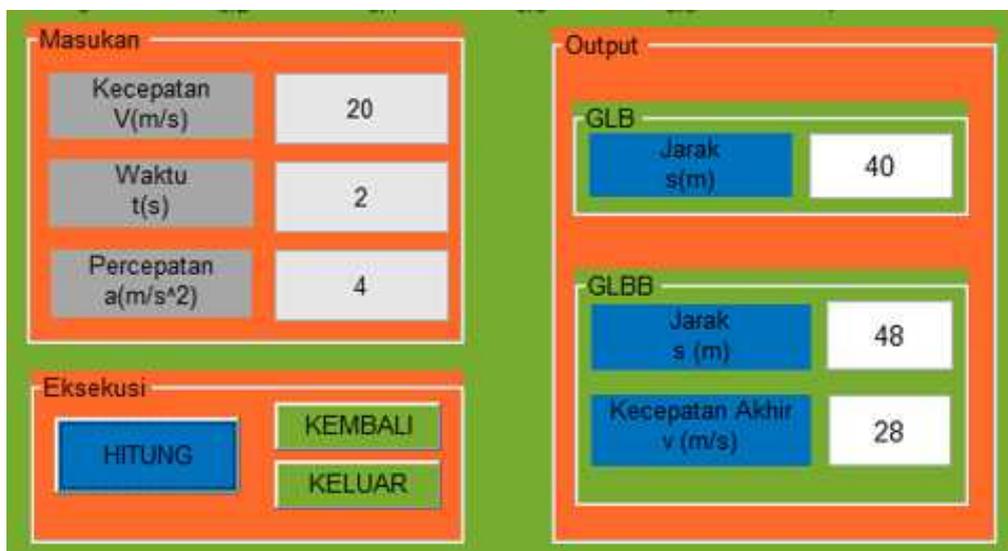
Figure 3. Example of calculating distance on GLB, distance and speed on GLBB

Manual calculations for the examples of distance and speed calculations above, namely:

Distance on GLB

$$s = vt = (20 \text{ ms}^{-1})(2s) = 40 \text{ m} \tag{4}$$

Distance on GLBB

$$s = v_o t + 0.5a\, t^2 = (20\text{ms}^{-1})(2s) + 0.5(4\text{ms}^{-2})(2s)^2 = 48 \text{ m} \tag{5}$$

$$v_t = v_o + at = 20\text{ms}^{-1} + (4\text{ms-2})(2s) = 28 \text{ ms}^{-1} \tag{6}$$

Discussion

By analyzing the sample questions above, it can be stated that the physics calculator for the GLB and GLBB materials that have been made can be used properly. This is evidenced by, 1) when the *user* clicks the 'Calculate' button, both on the speed value, the GLBB results immediately come out. Without any warning on the *command windows screen* stating an error. 2) the values in the calculation examples above (figure 3), both from GLB and GLBB when calculated manually are the same value. By using the Matlab application as a tool in working on physics problems, satisfactory results were obtained. Students feel happy using the MATLAB application in learning physics (Aminah, 2021).

Based on the discussion and analysis above, the GUI Matlab learning media has been used to make a physics calculator for the GLB and GLBB materials. This can be seen from several articles that have been published about the use and manufacture of physics calculators based on the physics of motion material as discussed above. These materials include kinematics, vertical motion, Newton's motion, the pulley system, work and energy. In addition, on this occasion, a physics calculator for GLB and GLBB materials has also been made. Then, research has also been conducted on interest in learning physics using Matlab. The results obtained are 72.35% stating that students enjoy learning physics using MATLAB.

And the results obtained that students understand more about physics by using matlab (Astuti & Alhidayatuddiniyah, 2020).

Conclusion

Several physics calculators have been made using the Matlab GUI which are used as learning media. From the results of the literature study, no physics calculator has been made for GLB and GLBB materials. So the researchers made a physics calculator with this material using the Matlab GUI. Some research results state that physics calculators made using the Matlab GUI can be used properly in calculating physics problems. This is evidenced by the absence of an *error sign* in the *command window* when clicked ' *Run* ' or 'Calculate', and the results of the calculation of the questions that appear are the same as the results of manual calculations. In addition, based on some literature shows that the MATLAB GUI can be used as a learning medium in Physics subjects about straight motion. The existence of this Matlab GUI-based Physics calculator media can make it easier for students to understand the concepts of Physics as outlined in computer language.

Recommendation

The development of the use of the Matlab GUI should be done in different cases so that the results are more diverse. For example, in parabolic motion and circular motion

References

Agustinasari, A., & Sumarni, R. A. (2021). Alat Penghitung Fisika Pada Materi Gerak Vertikal Berbasis Matlab. *Semnas Ristek (Seminar Nasional Riset Dan Inovasi Teknologi)*, *5*(1), 741–744.

Alhidayatuddiniyah, W. T., & ... (2020). Perancangan Aplikasi Kalkulator Kinematika pada Mata Kuliah Fisika Gerak Berbasis Matlab. *SINASIS (Seminar …*, *1*(1), 1–5. http://www.proceeding.unindra.ac.id/index.php/sinasis/article/view/4053%0Ahttp://www.proceeding.unindra.ac.id/index.php/sinasis/article/viewFile/4053/609

Astuti, S. P., & Alhidayatuddiniyah, T. W. (2020). Pemanfaatan Software Matrix Laboratory (Matlab) Untuk Meningkatkan Minat Belajar Mahasiswa Dalam Pembelajaran Fisika Kinematika. *J. Pendidikan Berkarakter*, *3*(2), 54–57.

Hasrawati, & Imansyah, M. N. (2018). Pengembangan Media Pembelajaran Menggunakan Matlab Pada Kompetensi Dasar Sistem Telekomuikasi di SMK Telkom Makassar. *Jurnal Ilmiah Ilmu Pendidikan*, *1*(1), 31–37.

Hutagalung, S. N., & Panjaitan, M. (2018). Pembelajaran Fisika Dasar dan Elektronika Dasar (Arus, Hambatan dan Tegangan Listrik) Menggunakan Aplikasi Matlab Metode Simulink. *Jurnal Ikatan Alumni Fisika Universiyas Negeri Medan*, *4*(3).

Liu, G., & Gao, Y. (2012). The application of MATLAB in communication theory. *Procedia Engineering*, *29*, 321–324. https://doi.org/10.1016/j.proeng.2011.12.715

Mada Sanjaya. (2013). Komputasi Fisika untuk Sains dan Teknik menggunakan Matlab. Yogyakarta: Penerbit Andi

MS, A., & Baysha, M. H. (2018). Pengaruh Media Pembelajaran Matrix Laboratory (Matlab) Terhadap Hasil Belajar Siswa. *Jurnal Teknologi Pendidikan*, *3*(2), 10–20.

Mulyawati, C., Salmawati, S., Subianto, M., & Wafdan, R. (2017). Teaching Media Development of Mathematic in the Materials Trigonometry Sum and Two Angles Difference By Using Gui Matlab. *Jurnal Natural*, *17*(2), 69. https://doi.org/10.24815/jn.v0i0.7032

Negara, H. R. P., Syahruddin, & Kurniawati, Kiki, R. S. (2018). Design GUI of Simulation And Numerical Solution of Equation And Non Linier Equation Systems. *Jurnal Riset Teknologi Dan Inovasi Pendidikan (JARTIKA)*, *1*(2), 90–98.

Nugraha, A. M. (2020). Graphic User Interface (GUI) untuk materi dinamika gerak sistem katrol berbasis matlab. *Navigation Physics : Journal of Physics Education*, *1*(2), 51–58. https://doi.org/10.30998/npjpe.v1i2.200

Okyranida, I. Y., Widiyatun, F., & Asih, D. A. S. (2021). Perancangan Aplikasi Kalkulator Fisika Pada Materi Gaya Newton. *Jurnal Inovasi Penelitian*, *1*(8), 1663–1668.

Puji, S., & Handayani, S. (2020). *Navigation Physics Jo u r n a l o f P h ys ic s E d u c a t io Perancangan Aplikasi Konversi Besaran Berbasis Matlab Untuk Mahasiswa*. *2*(1), 25–29.

Raihanah, A., Putri, O. R. U., & Effendi, M. M. (2020). Literasi Digital dan Pemahaman Konsep Himpunan Siswa SMP Menggunakan Media Pembelajaran GUI Matlab. *Jurnal Elemen*, *6*(1), 13–24. https://doi.org/10.29408/jel.v6i1.1309

Sen, S. K., & Shaykhian, G. A. (2009). MatLab tutorial for scientific and engineering computations. International Federation of Nonlinear Analysts (IFNA); 2008 World Congress of Nonlinear Analysts (WCNA). *Nonlinear Analysis, Theory, Methods and Applications*, *71*(12), e1005–e1020. https://doi.org/10.1016/j.na.2009.01.069

Sumarni, R. A., Juliardi, M., Widiyatun, F., Astuti, I. A. D., Okyranida, I. Y., & Bhakti, Y. B. (2021). MATLAB-based physics calculator: Alternative for learning media for work and energy concept. *Journal of Physics: Conference Series*, *1806*(1). https://doi.org/10.1088/1742-6596/1806/1/012022

Syaharuddin, Negara, H. R. P., Mandailina, V., & Sucipto, L. (2017). Calculus Problem Solution And Simulation Using GUI Of Matlab. *International Journal of Scientific & Technology Research*, *06*(09), 275–279.

Widiyatun, F. (2021). *Fita Widiyatun, et al / GUI Matlab Untuk Pembuatan*. *2*(1), 435–442.

Yosua, R., Fauzan, A., Kistiani, K., & Astuti, I. A. D. (2020). Aplikasi KALFIS (Kalkulator Fisika) berbasis matlab untuk membantu analisis eksperimen fisika. *Navigation Physics : Journal of Physics Education*, *1*(2), 59–62. https://doi.org/10.30998/npjpe.v1i2.201

Zulkarnain. (2020). Solusi Numerik Logika Fisika Berbasis Matlab Algoritma. Malang: Ahlimedia Book.