

Application Physics Calculator's of Two Dimension Kinematics Based-Android

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Abstract. Physics learning is often conceptualized as involving either progress from absence to presence of relevant physics concepts or progress from naive theories to theories consistent with physics principles. Advances in technology have brought people to the digital age. One device that utilizes technology is a smartphone. Motion is the movement of the position of objects against time. Object motion can be explained using the coordinate axis. The independence of the x and y motions lies the heart of two dimensional kinematics. To facilitate calculation in two-dimensional kinematics material, built application Physics calculator's of two-dimensional Kinematics motion. The design of the application using a flowchart and Sketchware applications that can run on the Android platform, so users can use the application anywhere by smartphone.

Keywords: calculator, physics, two-dimensional kinematics, android.

1 Introduction

During the last decade, the use of smartphones among teenagers in their daily life has grown significantly. In order to overcome this situation, we have developed Serious Physics, a free mobile app that allows using smartphones as measuring tools to conduct experiments on Physics [1]. The development of science and technology increasingly encourage efforts to improve the quality of education by utilizing the results of technology in learning. Learning Physics is not just about mathematics, but more students are expected to be able to understand the concepts contained therein, write them down into physical parameters or symbols, understand the problems and solve them mathematically [2].

Physics learning is often conceptualized as involving either progress from absence to presence of relevant physics concepts or progress from naive theories to theories consistent with physics principles. Explicit mention within the problem of the relevant physics concept was found to influence considerably students' choices of approaches for representing and solving problems [3].

The equation used in making this calculator is on two-dimensional motion. This motion explore the kinematics of a particle moving in two dimensions. Knowing the basics of two-dimensional motion will allow to examine a wide variety of motions. This motion begin by studying in greater detail the vector nature of position, velocity, and acceleration. It derived the kinematic equations for two-dimensional motion from the fundamental definitions of these three quantities. The position vector for a particle moving in the xy plane, the component form of the equations for two-dimensional motion is equivalent to two independent motions, one in the x direction and one in the y [4]. Equations of motion kinematics of particle moving in two dimensions are shawn in table 1.

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Table 1. Equations of motion in two dimension.

X direction	Y direction
$v_x = v_0 + at$	$v_y = v_0 + at$
$x = x_0 + \frac{1}{2}(v_0 + v_x)t$	$y = y_0 + \frac{1}{2}(v_0 + v_y)t$
$x = x_0 + v_0t - \frac{1}{2}at^2$	$y = y_0 + v_0t - \frac{1}{2}at^2$
$v_x^2 = v_0^2 - 2a(x - x_0)$	$v_y^2 = v_0^2 - 2a(y - y_0)$

Then treat projectile motion and uniform circular motion as special cases of motion in two dimensions: projectile motion and circular motion.

1.1 Projectile Motion

To show that the trajectory of a projectile is a parabola, let us choose our reference frame such that the y direction is vertical and positive is upward. Because air resistance is neglected. Furthermore, let us assume that at $t=0$, the projectile leaves the origin ($x_0=y_0=0$) with speed v_0 , as shown in Figure 1.

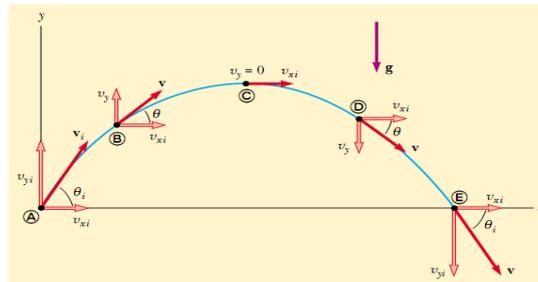


Fig. 1. The parabolic path of a projectile motion [5]

The vector v_i makes an angle θ_0 with the horizontal. the definitions of the cosine and sine functions are shown in table 2.

Table 2. Equations of Projectile motion.

X direction	Y direction
$v_x = v_0 \cos \theta$	$v_y = v_0 \sin \theta - gt$
$x = (v_0 \cos \theta)t$	$y = \frac{1}{2}(v_0 \sin \theta + v_y)t$
	$y = (v_0 \sin \theta)t - \frac{1}{2}gt^2$
	$v_y^2 = v_0^2 \sin^2 \theta - 2gy$

1.2 Circular Motion

Circular motion is a special case of motion on a plane, by specifying a radius r and an angular coordinate θ , as shown in Fig. 2. a. the origin coordinate system is at the center of the circle and the angle θ is measured from the $+x$ axis, increasing in the counter-clockwise direction [6].

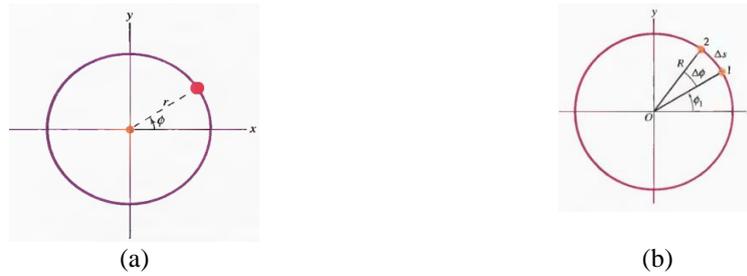


Fig. 2. (a) Radial variable r and angular variable θ of plane polar coordinates. (b) During the time interval Δt a particle in circular motion transverses an arc length Δs and an angle $\Delta\theta$ [6]

Consider a point object moving in uniform circular motion at a radius R from point 1 to point 2, as shown in Fig. 2.b. during the time interval Δt ($t_2 - t_1$) needed to travel between these points, the object moves through an angle $\Delta\theta$ ($\theta_2 - \theta_1$) [6]. So have angular velocity (ω):

$$\omega = \frac{\theta_2 - \theta_1}{t_2 - t_1}. \quad (1)$$

This distance along the circle is the arc length and denote it by Δs , so have

$$\Delta\theta = \frac{\Delta s}{R}, \quad (2)$$

and if time interval Δt limited to zero, so angular velocity is:

$$\omega = \frac{1}{R} v_t. \quad (3)$$

This paper builds on the authors' previous work, the calculator does more than calculating numbers or solving equations; rather, the calculator includes an adaptable menu and sub-menu system that helps a user analyze a problem, determine the type of the problem, and helps a user choose equations that are needed to solve the problem. The calculator includes at least some of these topics about the electricity. Additionally, the calculator prompts users to input units for variables, performs unit analysis, and displays results with units. The invention can be implemented as a handheld calculator, as a computer program, or as a program for a handheld device such as a smart phone [7]. In 2010 Sun et.al have designed and developed an application by using aforementioned features in an Android phone to provide functionalities used in field studies [8]. Other research was development chemical literacy using Android-based educational game media, and produces educational game based on Android [9]. The author also has made an application calculator of one dimensional physics motion

[10], and build the application calculator of the mirror physics [11], application that designed with flowchart and input/output design, while its development is with sketchware software, and can run on the Android platform.

Sketchware create android apps on smartphone, bring imagination to life, the application is available on google play store, develop on the program, compile, and run straight on device. There is no complicated setup needed. Not need any prior programming experience. Simply connect lego-like blocks to create logics for this application, finished projects are automatically translated into Java and XML. project is fully compatible with android studio, can share finished projects, like and comment on favorite projects, and see what others are thinking and creating [12].

In line with previous studies, this study discusses the development of android-based applications that can be used to facilitate calculations in physics, especially on the material of two-dimensional kinematics. The app was built with Sketchware software, which runs on the Android platform.

2 Method

The research, titled "Application Physics Calculator's of Two Dimension Kinematics Based-Android" is research of software engineering (research and development). The method used is Software Development Life Cycle (SDLC). The research stages are as follows:

- 1) Data Collection
At this stage, data collection is done in the material of Motion 2 Dimensional Kinematics and formulas related to the material.
- 2) Analysis
After data collection, the next step is to analyze the needs of the system.
- 3) Design
At this stage that system design is done using flowchart, in addition it is also designed interface (input/output).
- 4) Implementation
The app is built with sketchware software that can run on Android platform. In Sketchware there are 2 parts: View and Logic. In the implementation stage, preparation of View and Logic according to the design that has been made is done.

3 Design and Implementation Systems

3.1 Flowchart Systems

This application designed by flowchart systems. There are two main menus that are projectile motion and curcular motion. The flowchart shown in Fig 3.a. In projectile motion menu there are two menus that are projectile motion x direction and projectile motion y direction, as shown in Fig 3.b.

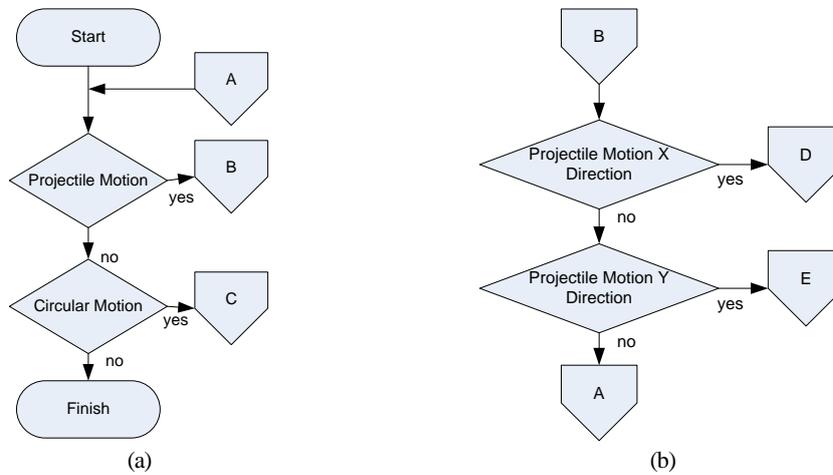


Fig. 3. (a) Flowchart main menu (b) Flowchart projectile motion menu.

In circular motion menu there is one menu that is angular velocity, as shown in Fig 4. In projectile motion x direction menu there are two menus that are velocity and displacement, as shown in Fig 5. In projectile motion y direction menu there are two menus that are velocity and displacement, as shown in Fig 6.

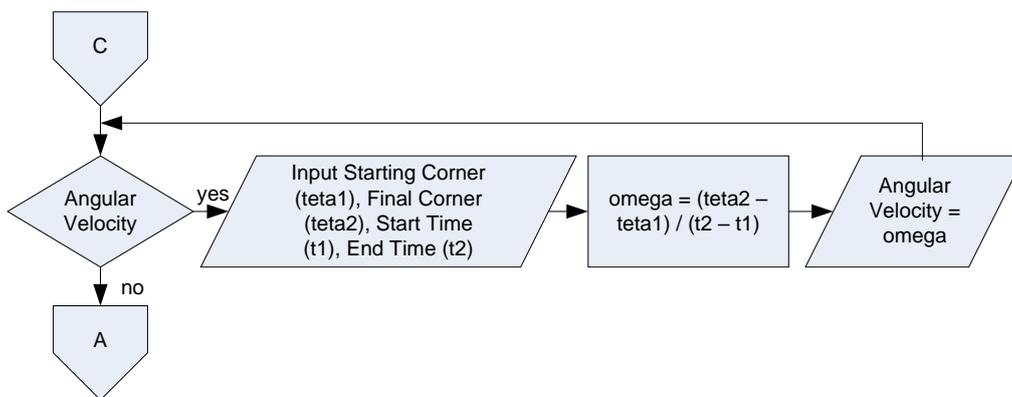


Fig. 4. Flowchart circular motion.

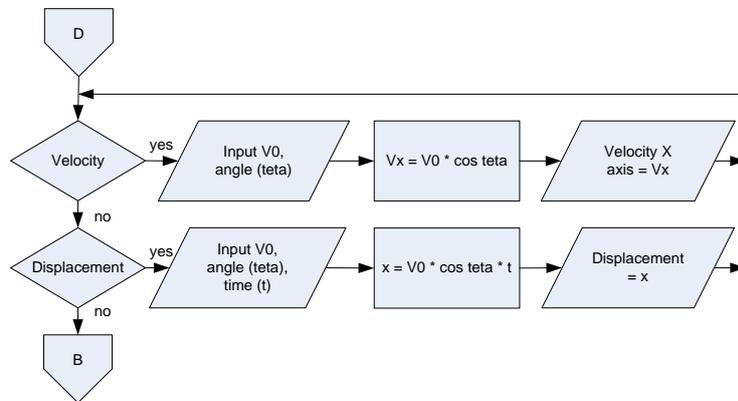


Fig. 5. Flowchart projectile motion x direction menu.

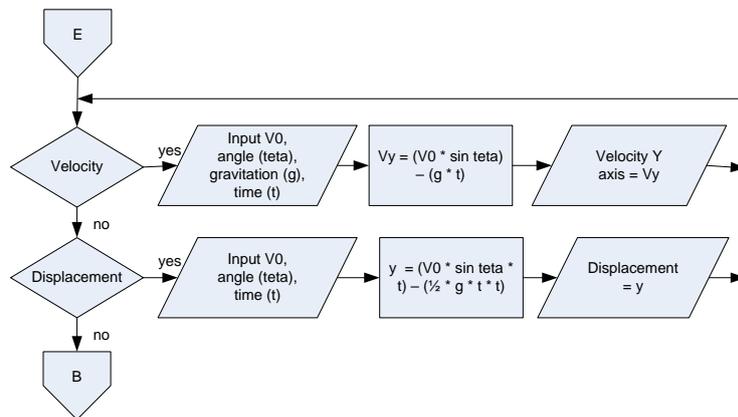


Fig. 6. Flowchart projectile motion y direction menu.

3.2 Implementation Systems

Application Physics Calculator's of Two Dimension Kinematics was built in Sketchware. In Sketchware there are two parts that are View and Logic. View is used to manage the appearance of the application while Logic is used to manage events and components of the application. There are some important events in this application. Fig 7 is used to run a calculation an angular velocity. In projectile motion both x direction and y direction, there are two button that used to calculation, as shown in Fig 8 and 9. Fig 8.a. shows the event to calculate the velocity in projectile motion x direction while Fig 8.b. shows the event to calculate the displacement in projectile motion x direction. Fig 9.a. shows the event to calculate the velocity in projectile motion y direction while Fig 9.b. shows the event to calculate the displacement in projectile motion y direction.

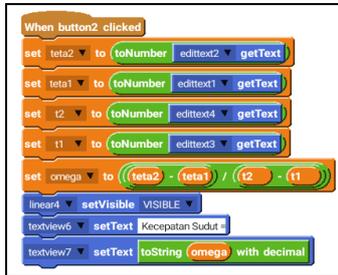
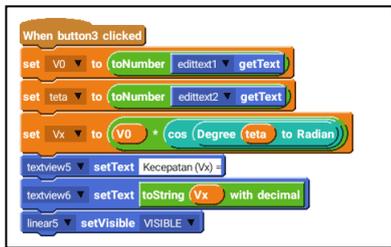
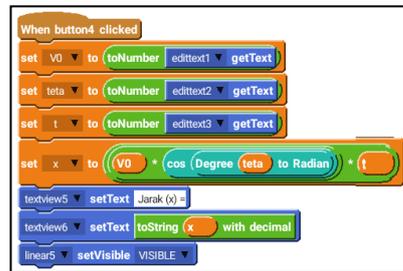


Fig. 7. Event button2 clicked in Angular Velocity.

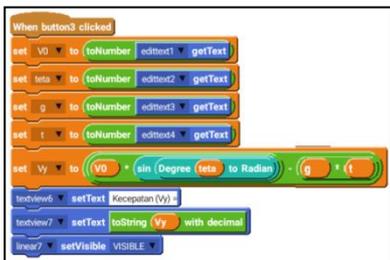


(a) button3 clicked

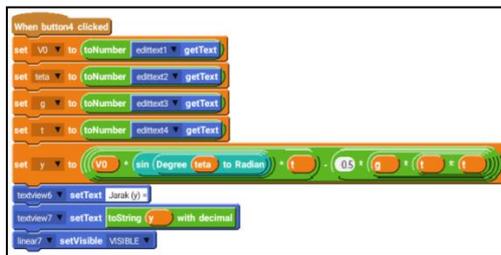


(b) button4 clicked

Fig. 8. Event button clicked in projectile motion x direction.



(a) button3 clicked



(b) button4 clicked

Fig. 9. Event button clicked in projectile motion y direction.

4 Conclusion

Conclusions that can be taken based on the results and discussion above are:

- (1) Physics Calculator's of Two Dimension Kinematics has been generated which can be used on the Android platform.
- (2) The calculator provided includes calculating projectile motion and circular motion at displacement, velocity, and acceleration.

Suggestions for further research include:

- (3) Applications can be developed by giving additional illustrations of motion in accordance with the input value and output produced.
- (4) Calculator can be developed into a Physics calculator's in general by giving additional units and applying complete Physical material.

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References

- [1] L. Martinez and P. Garaizar, "Learning physics down a slide: a set of experiments to measure reality through smartphone sensors," in *IEEE Global Engineering Education Conference (EDUCON)*, 2014.
- [2] S. Rezeki and Ishafit, "Pengembangan lembar kerja siswa (LKS) berbantuan media simulasi dengan modells untuk pembelajaran kinematika di sekolah menengah atas," in *Seminar Nasional Pendidikan Fisika*, 2017, pp. 130–133.
- [3] D. P. Maloney and R. S. Siegler, "DavidConceptual competition in physics learning," *Int. J. Sci. Educ.*, vol. 15, no. 3, pp. 283–295, 2007.
- [4] R. A. Serway and J. W. Jewett, *Physics for Scientists and Engineers*, 6th ed. Thomson Brooks/Cole, 2004.
- [5] P. A. Tipler and G. Mosca, *Physics for Scientists and Engineers*, 6th ed. Macmillan Higher Education, 2008.
- [6] P. M. Fishbane, S. G. Gasiorowicz, and S. T. Thomson, *Physics for Scientists and Engineers with Modern Physics*, 3rd ed. United States of America: Pearson Prentice Hall, 2005.
- [7] D. Amare, "Chemistry and physics calculator," US20130042197A1, 2013.
- [8] F. Sun, Y. Weng, and J. D. Grigsby, "Smartphones for Geological Data Collection- an Android Phone Application," in *American Geophysical Union*, 2010.
- [9] S. Sari, R. Anjani, I. Farida, and M. A. Ramdhani, "Using Android-Based Educational Game for Learning Colloid Material," *J. Phys.*, vol. 895, no. 1, 2017.
- [10] T. Khotimah and F. S. Hilyana, "Kalkulator Fisika Gerak Satu Dimensi Berbasis Android," *Simetris*, vol. 9, no. 1, pp. 541–546, 2018.
- [11] T. Khotimah and F. S. Hilyana, "Aplikasi Kalkulator Fisika Pencerminan Berbasis Android," in *SNATIF*, 2017, pp. 15–24.
- [12] Sketchware, "Sketchware - IDE in Your Pocket," 2016. [Online]. Available: <http://sketchware.io/>.