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DESIGN AND CONSTRUCTION OF MODELING TOOL OF LINEAR MOTION EXPERIMENT ASSISTED TOY CARS WITH REMOTE CONTROL FOR VIDEO TRACKER ANALYSIS

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ABSTRACT

Physics has an important role in development and technology. Physics is concerned with experiment. From the results of research that has been carried out, it is known that there is no linear motion of kinematics experiment with speed control and the use of an inclined plane for the sliding plane of the linear motion experiment. The limitation of the instrument in displaying physical measurement quantities is one of the reasons. To overcome this limitation, a modeling tool assisted by a remote control toy car and analyze it using tracker software is created. The purpose of this study is to determine the performance specifications of the modeling tool for linear motion experiments assisted by a remote control toy car, determine the value of the accuracy and precision of the modeling tool, and also determine the correlation of physical quantities in linear motion experiments. Based on the results of data analysis using tracker software, there are three results can be explained. First, the performance specifications of linear motion experimental modeling tool with the length of the glide plane being 2 m and a width of 30 cm. The use of a dc motor, bluetooth module using an android connected to the HC-05. Second, the accuracy of the measurement of time and speed in the LMCV experiment was 98.4% and 97.2%. The accuracy values for the measurement of acceleration and velocity in the LMCA experiment were 95.53% and 95.5%. Third, in LMCV the correlation between position and time is in the form of a linear line, the correlation between velocity and time is in the form of a straight line with a constant value.

Keywords : Linear motion experimental; Tracker; Video Analysis.

I. INTRODUCTION

Physics has an important role in development and technology. There are important discoveries in physics due to physics experiment. This experiment is very important for studying physics, this can be seen from what physics is [1]. Physics is a knowledge base on experimental observations [2]. The most important thing in physics experiments is experimental set or physics instrument. One of the experiments in physics is the kinematics of motion, where this kinematics contains a discussion of motion without regard to the cause of the object moving. This discussion is limited to the kinematics of linear motion, especially linear motion with constant velocity (LMCV) and linear motion with constant acceleration (LMCA).

The kinematics of motion is one of the experimental physics. The linear motion experiment is still limited in the parameters of the measurement results. This is indicated by the direct measurement results parameters are only limited to the calculation of time. In addition, the linear motion experiment still uses manual instruments and the speed of the dynamo car in the ticker timer experiment has the same rate value. The solution to overcome this limitation is to created a modeling tool for linear motion experiments assisted by a toy car with a remote control and analyze it using tracker software. One way out of this problem is to develop experimental video analysis and modeling tools [3]. Tracker is a software that can analyze parameters such as speed, position, acceleration of a moving object [4]. Tracker Video Analysis can track moving objects based on video frames uploaded into the software, therefore the experiment must be recorded first [5].

Motion means that there is a change in the position of an object with respect to a certain reference point [6]. Whereas what is meant by linear motion is the motion of an object or particle on a linear path or linear line [7]. LMCV is the motion of an object in a straight line where the object has a constant speed every time [8]. Every time objects experience a change in position. Constant velocity means that the object has a constant magnitude or direction. The acceleration of an object in uniform straight motion is zero because the object does not experience a change in velocity [9]. Based on Amalia (2021), the linear motion with constant velocity equation can be seen in Equation 1

$$V = \frac{s}{t} \tag{1}$$

Linear motion with constant acceleration (LMCA) is a type of linear motion where the speed changes regularly per unit time [10]. This type of linear motion has an acceleration which means that the magnitude and direction are fixed [8]. Because the acceleration in a straight line changes uniformly with a constant or constant value, the graph of the correlation between acceleration and travel time is in the form of a straight line. Based on Amalia (2021) the equation for LMCA can be seen in Equation 2

$$a = \frac{v_t - v_o}{t} \tag{2}$$

This linear motion experiment modeling tool has a speed level control. A collection of electronic components that make up a system is called control [11]. Controlling the speed of the toy car using a remote controller that has been programmed on android. Android will be connected to the toy car via bluetooth on android and will be connected to the HC-05 bluetooth module on the toy car which will be processed by arduino nano. Arduino functions as a command processor from bluetooth which will later run a DC motor.

Arduino nano is a small Arduino board [12]. Arduino nano has the same function as Arduino uno which has everything needed for a microcontroller, the only difference is in size [13]. This type of Arduino is widely used in industry because it has a small size. The disadvantage of this type of Arduino is that it does not have a port for DC power and can only use a Mini-B USB cable.

Bluetooth HC-05 is an electronic component that has a function as a communication tool that uses radio frequencies to connect devices such as Android with a certain range. The bluetooth module is connected to a microcontroller which will process input commands from android which are sent via bluetooth android. The range that can be reached by Bluetooth HC-05 is 10-20 m. DC motor is an electronic component that converts electrical energy into motion energy. DC motors have a rotor and a stator, the rotor as a rotating part while the rotor where it produces a magnetic field [14].

The previous research regarding the kinematics of LMCV and LMCA using a microcontroller. In this study the measurements used a photodiode sensor as a sensor [15]. In the next study, a measuring device for LMCV and LMCA is to use a ticker timer using the LE8N timer series as an automatic timer, this tool uses a dynamic train for sliding objects that have been connected to paper tape at the ends, which later the results of the typing of the tool will be observed whether it is uniform straight motion or uniformly changing rectilinear motion [16]. Measuring time when carrying out tests is still done manually, so experiments take a long time, so a follow up software is needed that facilitates the smooth running of experiments in the laboratory. Based on the background of the problem that has been described, the researcher is interested in making an experimental modeling tool from linear motion. Therefore, the researcher raised the title of the study entitled "Design and Construction of a Modeling Tool Linear Motion Experiment Assisted Toy Cars With Remote Control for Video Tracker Analysis". The purpose of this research is to determine the performance specifications of the modeling tool experiment with linear motion assisted by a toy car with a remote control, determine the design specifications of the modeling tool, and determine the correlation between physical quantities in linear motion.

II. METHOD

This research lasted for eleven months with several stages of activity. Several stages of activities carried out are preparation, literature review, implementation, and preparation of the final report. The type of research carried out is engineering research. Engineering research or research and development produces tested models, formulas, algorithms, data structures, and products [17]. The tools and materials needed for research are a PC to run the tracker software, a camera to record experimental videos, tracker software, a linear motion modeling tool assisted by a remote control toy car, linear motion kinematics videos that have been recorded using a camera, an android with a control application installed toy car speed. The modeling tool consists of several electronic components including a dc motor, bluetooth hc-05 module, arduino nano. In this study using closed control, because if there is a disturbance in the movement of the motor through the relay, there will be feedback to the microcontroller to move the car [18]. Arduino is one tool that is useful for making a number of devices by combining sensors, controlling lights, motors, and a number of other electronic devices [19].

The design consists of software design and hardware design. The software design is to analyze the video using a tracker from the experimental results of linear motion with constant velocity and linear motion with constant acceleration, while the hardware design consists of an electronic circuit design from a linear motion experiment assisted by a remote control toy car.

The detailed mechanical design of the linear motion modeling tool assisted by a remote control toy car is related to the tools and materials used. The design of the modeling tool for a linear motion experiment with the aid of a remote control toy car can be seen in Figure 1:

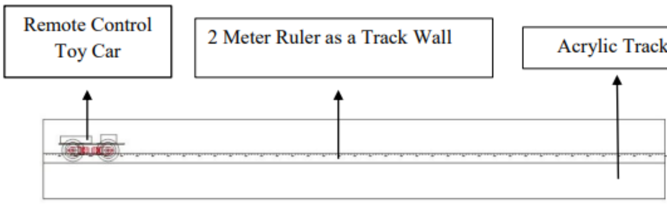


Fig 1. Design of a Linear Mootion Experiment with Remote Control Toy Car

The design uses android as a controller or input for various electronic components that have the function of each car running which consists of a remote control. The input from the modeling tool is in the form of a motor speed level that can change continuously, so that for LMCA experiments it is not necessary to use an inclined glide plane. The color of the track with the toy car is given a contrast so that the tracker can distinguish the moving object to be analyzed.

Block diagrams are needed to create a system so that the system can run ideally. The block diagram for the modeling tool can be seen in Figure 2:

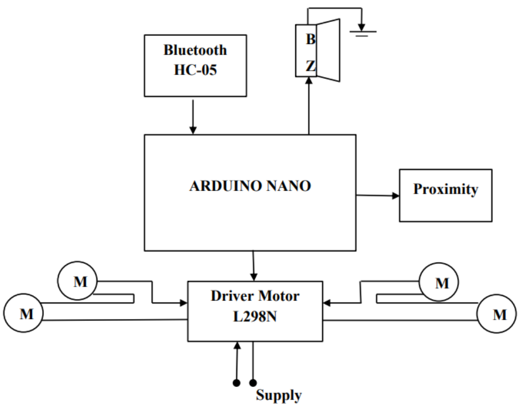


Fig 2. Block Diagram Modeling Tool

From the block diagram as shown in Figure 2, it is described that the experimental device uses a dc motor as a driver which is connected to the motor driver. Arduino nano is used as a microcontroller or program store that will translate commands that have been sent from bluetooth. The proximity sensor here only functions as a safety for the car, if there is a barrier in front of the car, the sensor will give a signal and automatically turn off, this is advantageous so that the battery from the car does not run out quickly. When the car is turned on, the buzzer will turn on which is an indicator that the car is on. The programming design of the modeling tool can be seen in Figure 3:

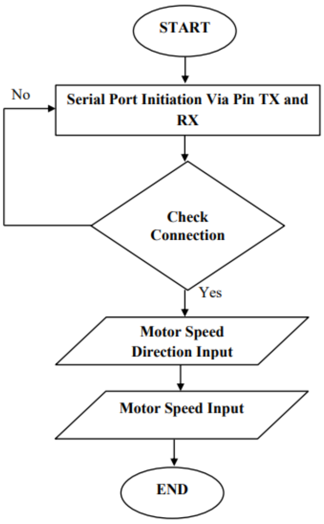


Fig 3. Modeling Tool Software Design

Based on Figure 3, a flow diagram of the design and construction of a linear motion modeling tool assisted by a toy car with a remote control for video tracker analysis. The first step that must be done is to determine the logic that will be applied to the car controller system, which will later be implemented using Arduino. First, the user will be directed to check the connection on the android application program whether it is connected to the bluetooth module on the car, after that the command is received by arduino. Then, the user can input the speed direction of the motor, whether the motor is moving clockwise (forward) or counterclockwise (backward). After that input the speed level of the motor through the application whether the car is moving slowly or fast.

The implementation of research procedures is carried out in accordance with the existing steps in this type of engineering research. These steps are determining the idea of making the modeling tool, compiling a design concept where the researcher realizes the idea from the modeling tool, making block diagrams from the modeling tool, making a detailed design from the modeling tool, and the last stage is testing the feasibility of the modeling tool.

III. RESULTS AND DISCUSSION

Mathematica Conducting theoretical studies and producing a linear motion modeling tool assisted by a remote control toy car. The results of the research that have been carried out are almost the same as the design and theoretical studies that have been put forward. The research results consist of performance specifications, design specifications, and the correlation of physical quantities to the modeling tool.

The first result of the research that has been achieved is the performance specification of a straight motion modeling tool assisted by a toy car with a remote control. The performance specification is the identification or description of the functions of each system-forming part of the modeling tool [20]. The performance specifications of the linear motion experimental modeling tool assisted by a remote control toy car include mechanical design, software design which includes control and software used. This mechanical design includes the components that make up the linear motion modeling tool. Controlling the speed level on a remote control car will use a DC motor. The software that will be used is software that supports experimental research of uniform and changing motion in the form of video analysis. Mechanical design serves to describe the parts of the modeling tool. The mechanical design of the straight motion experimental modeling tool can be seen in Figure 4:

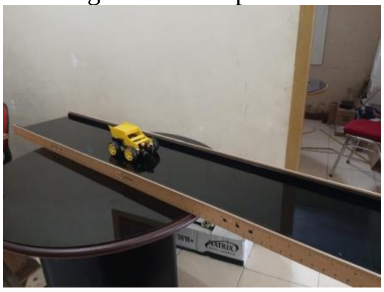


Fig 4. Tool Modeling Linear Motion Experiment Assisted Toy Cars

Based on Fig 4, the linear motion modeling tool is made of acrylic. This experimental set has a flat plane, with the dimensions of the field having a length of 2 meters and a width of 30 centimeters. This experimental set is black in contrast to the car so that when performing video analysis using the tracker software, it can be easily recognized or distinguished from a moving car.

Speed control from a remote control toy car in a linear motion experiment using a 7.4 V 50 mAh lipo battery, HC-05 bluetooth module, DC motor gear box, and L298N motor driver. Batteries are needed to enable providing current to the dc motor. The battery provides a direct voltage of 7.4 V through the motor driver. When the speed value has been inputted and displayed via android which will be sent to the bluetooth module, the arduino will process it in the program that has been made so that the dc motor can operate and move on the glide plane according to the value that has been inputted. The components that make up the remote control car speed control can be seen in Figure 5:

Fig 5. Speed Control Components

Based on Fig 5, the components consist of a 7.4 V 50 mAh battery, a dc motor, and a bluetooth module. These components are used to regulate the motor speed. In general there are three components of motor speed control, namely two units of 3.7 V Lipo Battery, DC Motor, and Bluetooth Module HC-05. The combination of several electronic circuits is called a control system [11].

The speed of the motor will be controlled through an application from the smartphone which will be sent using bluetooth to the HC-05 bluetooth module and processed by the microcontroller. The remote control display on a smartphone can be seen in Figure 6:

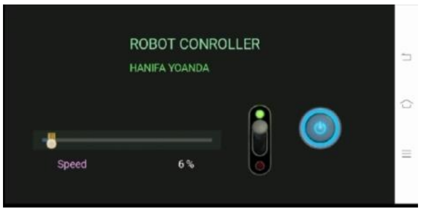


Fig 6. Display Remote Controller

Based on fig 6 this application can be downloaded via the play store under the name bluetooth electronics. In this application we can design a remote control using our own program easily using the Arduino program which will later be connected to the car. In this application, which is controlled by a remote control, including the motor speed level, the car on off switch, and the hot direction of the car, namely forward and backward. The results of the specification of tool performance can be said to be good through the identification of the functions of each part forming the tool modeling system [21]. The results of the performance specifications of this linear motion modeling tool are suitable for experimenting with uniform straight motion and uniform changing linear motion. This tool is composed of a flat glide plane, a remote control car consisting of a dc motor, arduino, bluetooth module, motor driver, the speed of the motor can be changed as needed for linear motion experiments and continuous speed for uniform linear motion experiments without using inclined glide plane. Kinematics of motion is part of mechanics which studies the motion of an object without considering the cause of the object moving, an object is said to be moving when it experiences a change in position from its reference point [22].

The result of the modeling tool design specifications is the value of the accuracy and precision of the modeling tool measurements. Every measurement will definitely produce an error or measurement error. This can occur due to limited tools, environmental factors, or there is an error in making measurements. So that the error obtained is not too large, it is necessary to carry out repeated measurements [23]. In this study, measurements of the accuracy and precision of each tool were carried out 10 times. The accuracy value in the LMCV experiment was obtained from the measurement of four speed variations. The results of the accuracy of the LMCV are obtained by comparing the value of the travel time measured using a stopwatch, the speed find based on the LMCV formula is compared with the travel time and speed that has been analyzed by the tracker software. The results of the test were carried out for four experiments, the accuracy of the measurements can be seen in Table 1.

Table 1. Experimental Accuracy Value of LMCV

Formula			Tracker			Experimental Accuracy Value		Error Value	
t (s)	v (m/s)	x (m)	t(s)	v (m/s)	x (m)	t (%)	v (%)	t (%)	v (%)
6,00	0,33	2,00	5,84	0,34	2,00	97.33	96,96	2,66	3,03
5,16	0,38	2,00	5,16	0,39	2,03	97,00	97,36	3,40	2,63
4,32	0,43	2,00	4,36	0,45	1,96	99,07	97,82	0,90	2,17
4,10	0,49	2,00	4,00	0,51	2,04	97,56	93,75	2,50	6,25
				Average		98,49	97,22	2,40	3,52

Based on the data in Table 1, it can be described that the comparison of measurements from the modeling tool set of LMCV experiments with the values that have been searched for by formulas. It can be seen that the value read on the tracker with the value find by using the kinematics formula for regular linear motion has a value that is not much different. The average accuracy value from the results of the analysis of travel time using this tracker is 98.49% and the accuracy value of the speed analysis using the tracker is 97.22%. The average value of the travel time error using tracker software is 1.49% while the speed is 3.52%. This shows that the tracker can prove the value of speed and travel time experienced by objects is the same as the value of speed and travel time that is known based on theory.

The measurement accuracy value in the LMCA experiment was obtained from three variations of acceleration. The speed in this measurement increases continuously. Three variations of acceleration are obtained from changes in initial speed to final speed that have been inputted using the remote controller. The results of the test were carried out for three experiments, the accuracy of the measurements can be seen in Table 2.

Table 2. Experimental Accuracy Value of LMCA

Formula			Tracker			Experimental Accuracy Value		Error Value	
t (s)	x (m)	a (m/s²)	t(s)	x (m/s)	a (m/s²)	a (%)	t (%)	a (%)	t (%)
4,10	2,00	0,11	4,20	2,00	0,11	94,00	97,56	6,00	2,43
3,50	2,00	0,16	3,52	1,97	0,15	93,75	99,42	6,25	0,57
3,70	2,00	0,14	3,76	2,00	0,13	92,85	98,37	7,14	1,62
				Average		95,00	98,45	4,46	1,54

Based on the data in Table 2, it can be described the comparison of measurements from the LMCA experimental modeling tool set with the values that have been searched for by formulas. It can be seen that the value read on the tracker with the value find by using the LMCA kinematics formula has a value that is not much different. The average accuracy value of the acceleration using this tracker is 95.53% and the accuracy value of travel time using the tracker is 98.45%. For the average value of the acceleration error using a software tracker it is 4.46% while for the travel time is 1.54%. This shows that the tracker can prove that the acceleration and velocity values experienced by objects are the same as the velocity and acceleration values that are found based on theory.

The measurement accuracy of the modeling tool set for LMCV experiment is obtained by varying the speed level of the remote control toy car. The level of accuracy of the system can be determined by measuring ten times the measurement for each speed variation. From ten repeated measurements, it can be seen whether the tracker shows the same results (homogeneous data) or different. The accuracy test of the video tracker analysis was carried out on four variations of speed levels, namely 30%, 40%, 50%, and 60%. The results of the experiments that have been carried out, the value of time measurement of LMCV experiment can be seen in Table 3.

Table 3. Accuracy Value of Time Measurement For LMCV Experiment

No	Time (s) Measurement to-										Accuracy Value (%)	Error Value (%)
	1	2	3	4	5	6	7	8	9	10		
1	5,84	5,84	6,00	5,84	5,84	5,84	5,78	5,78	5,84	5,84	99,45	0,47
2	5,16	5,16	5,16	5,16	5,20	5,20	5,16	5,20	5,16	5,16	99,68	0,15
3	4,36	4,30	4,36	4,46	4,36	4,30	4,36	4,36	4,36	4,30	99,42	0,59
4	4,00	4,00	4,00	4,10	4,10	4,10	4,00	4,00	4,00	4,00	98,95	1,03

In Table 3, it can be described that the value of the travel time in the LMCV linear motion modeling tool for each measurement is almost the same. This proves that the data are homogeneous with each other. The accuracy value obtained is 99.37% and the percent error is 0.56%. This proves that the tracker has a good level of accuracy. The speed accuracy measurement values obtained in the LMCV experimental modeling tool are shown in Table 4.

Table 4. Accuracy Value of Velocity Measurement For LMCV Experiment

No	Velocity (m/s) Measurement to-										Accuracy Value (%)	Error Value (%)
	1	2	3	4	5	6	7	8	9	10		
1	0,34	0,34	0,34	0,34	0,30	0,30	0,30	0,34	0,34	0,34	93,75	6,25
2	0,39	0,39	0,39	0,39	0,40	0,40	0,40	0,39	0,39	0,39	99,23	0,76
3	0,45	0,45	0,45	0,45	0,44	0,42	0,45	0,45	0,45	0,45	97,72	2,26
4	0,51	0,51	0,51	0,51	0,51	0,50	0,50	0,51	0,51	0,51	98,40	1,60

In Table 4, it can be described that the speed values in the LMCV modeling tool for each measurement are almost the same. This proves that the data are homogeneous with each other. The accuracy value obtained is 92.27% and the percent error is 2.71%. This proves that the tracker has a good level of accuracy.

The measurement accuracy of the LMCA experimental tool modeling set was obtained by varying the final speed of the remote control toy car, where the speed of the toy car increased continuously. The level of accuracy of the system can be determined by measuring ten times the measurement for each speed variation. From ten repeated measurements, it can be seen whether the tracker shows the same results (homogeneous data) or different. The results of the experiments that have been carried out, obtained the values of velocity can be seen in the Table 5.

Table 5. Accuracy Value of Velocity For LMCA Experiment

No	Time (s) Measurement to-										Accuracy Value (%)	Error Value (%)
	1	2	3	4	5	6	7	8	9	10		
1	4,20	4,20	4,20	4,20	4,20	4,15	4,15	4,20	4,20	4,20	99,61	0,38
2	3,52	3,52	3,52	3,50	3,50	3,50	3,52	3,52	3,52	3,50	99,71	0,28
3	3,76	3,70	3,70	3,76	3,76	3,76	3,76	3,76	3,76	3,76	99,35	0,64

In Table 5, it can be described that the velocity values in the LMCA modeling tool for each measurement are almost the same. This proves that the data are homogeneous with each other. The accuracy value obtained is 99.50% and the percent error is 0.43%. This proves that the tracker has a good level of accuracy. The results obtained on the tracker software are acceleration values. The acceleration value in the LMCA experimental modeling tool is shown in Table 6.

Table 6. Accuracy Value of Acceleration For LMCA Experiment

No	Acceleration (m/s²) Measurement to-										Accuracy Value (%)	Error Value (%)
	1	2	3	4	5	6	7	8	9	10		
1	0,11	0,11	0,11	0,10	0,11	0,11	0,10	0,11	0,10	0,10	95,00	4,99
2	0,15	0,15	0,15	0,15	0,15	0,15	0,15	0,15	0,15	0,16	99,30	0,66
3	0,13	0,14	0,13	0,13	0,13	0,14	0,13	0,13	0,13	0,13	98,46	1,53

In Table 6, it can be described that the acceleration value in the LMCA modeling tool for each measurement is almost the same. This proves that the data are homogeneous with each other. The accuracy value obtained is 95.58% and the percent error is 2.39%. This proves that the tracker has a good level of accuracy.

In this study, measurements of the accuracy and precision of each tool were carried out 10 times. Accuracy data is obtained from comparing the time value that has been analyzed from the tracker with time that has been done using a stopwatch. The percentage value of the average accuracy obtained from the straight motion modeling tool for the experiment is 97,5%. The percentage error value is 2,5%. On the other hand, the average accuracy value obtained from the linear motion modeling tool is 98,8%. The percentage of the average accuracy error value obtained from the straight motion modeling tool is 2,1%.

The results of the accuracy and precision of the modeling tools that can be proven by using the applicable formula. The formula used is the kinematics formula for linear motion acceleration and velocity. The values obtained using a formula are compared with video analysis using tracker software. Comparison of the values obtained from the experiments that have been carried out by the tracker proves that the tracker can and is feasible to be used in other physics experiments related to motion [24].

The correlation between physical quantities that have been studied using a straight motion modeling tool and analyzed using tracker software. The experiments that have been carried out are the LMCV experiment and the LMCA experiment. For the graphic tracker display of the correlation between time and position in the LMCV experiment, it can be seen in Figure 7:

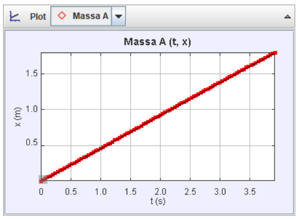
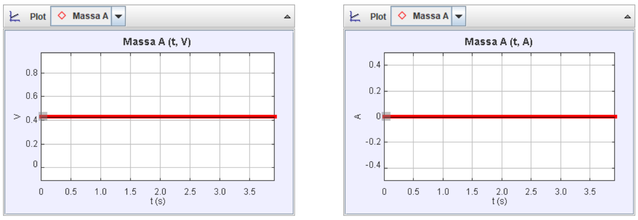


Fig 7. Correlation between Position and Time of LMCV

Based on Fig 7, the position of objects at each point changes. The correlation between position x and time t forms a linear graph. When an object is moving, the longer it takes the object to move, the farther the change in position is traveled by the object. This proves that the position of objects changes every time. Data analysis from tracker software also displays graph values of speed and acceleration. Graph of speed and acceleration of video tracker analysis in Figure 8:



(a) (b)

Fig 8. (a) Correlation between Velocity and Time (b) Correlation between Acceleration and Time of LMCV

The graph of the correlation between velocity and time is constant, this is because there is no change in velocity so that the acceleration is zero. The value of the object's acceleration with respect to time is constant, which is 0 m/s^2. The velocity with time graph in the experiement is imperfectly shaped like a straight line because the object observed using the tracker starts at a zero reference point, which means that when the time is equal to zero, it does not indicate the beginning of the object moving, but the initial object is observed.

Based on linear motion experiments that have been carried out, namely LMCV and LMCA. LMCV is a type of linear motion which has characteristics including, the correlation between time and position has a linear correlation which is indicated by a graph that has been analyzed using a tracker. The graph of the correlation between position and time shows that the object is observed at the reference point, namely the zero point, which means that when the time is equal to zero, it does not indicate the beginning of the object moving, but the initial object is observed [9]. In the LMCV motion, the correlation between speed and time is indicated by a straight line, because the speed is constant or the same for each unit of time, this can be proven by the results of the analysis using the tracker as has been done. Constant velocity is the state of an object when it moves the same distance and in the same time [25]. The correlation between acceleration and time is zero, this has been proven by the results of the tracker analysis. The acceleration in the LMCV experiment is zero because there is no change in velocity or the instantaneous velocity is equal to the average velocity.

For the graphic tracker display of the correlation between time and position in the LMCA experiment, it can be seen in Figure 9:

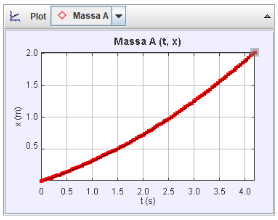
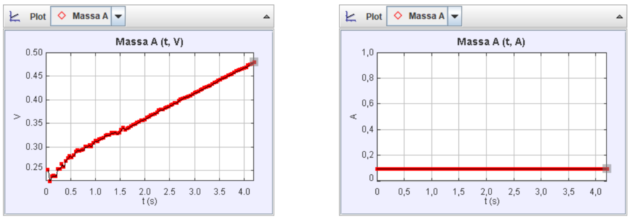


Fig 9. Position and Time Correlation of LMCA

Based on Figure 9, the position of the object at each point changes. The correlation between position x and time t forms a parabolic graph. When an object is moving, the greater the velocity of the object, the greater the change in position that the object travels. This proves that the position changes every time. Velocity and acceleration graph with a final velocity of 0.4 m/s from the video tracker analysis in Figure 10:



(a) (b)

Fig 10. (a) Correlation between Velocity and Time (b) Correlation between Acceleration and Time

Based on the graph that has been presented in Figure 10, the value of the object's velocity at each position is increasing with a final velocity of 0.4 m/s. The graph of velocity against time is linear. The velocity versus time graph in the LMCA experiment is imperfectly shaped like a linear line because the object being observed using the tracker starts at a zero reference point, which means that at time zero it does not indicate the beginning of the object moving, but the initial object is observed. LMCA is a type of linear motion that has a constant acceleration value, this is evidenced by the results of the analysis using a tracker. LMCA is a linear motion that experiences a changing velocity over time [15]. This is evidenced by the results of the tracker analysis where the graph of the correlation between speed and time is in the form of a parabolic line.

IV. CONCLUSION

Based on the results of testing and data analysis along with a discussion of the experimental set of linear motion assisted by toy car with remote control for video analysis and modeling tracker tools, several conclusions can be drawn from the research, namely. First, the results of the performance specifications of the straight-motion experimental modeling tool have a sliding plane length of 2 m and a width of 30 cm. The glide field in the experimental set is colored black with a 2 m-long dividing wall with a ruler. The remote control toy car is colored yellow to make it look contrast with the slide. Speed regulation using four mounted dc motors. The speed control component is composed of Arduino, Bluetooth as a communication connector between the car and Android as the speed input that has been installed by the application, and the battery as a power supply to drive the DC motor. Second, the results of the accuracy and precision of the linear motion modeling tool assisted by toy cars with remote contoller. Second, the accuracy of the measurement of time and speed in the LMCV experiment was 98.4% and 97.2%. The accuracy values for the measurement of acceleration and velocity in the LMCA experiment were 95.53% and 95.5%. Third, the correlation between physical quantities in linear motion at LMCV, the correlation between position and time is in the form of a linear line, the correlation between velocity and time is in the form of a straight line with a constant value, the correlation between acceleration and time is zero, while in LMCA the correlation between position and time is in the form of a parabola, velocity with time is in the form of a linear line, and the correlation between acceleration and time is in the form of a linear line which has a constant value.

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