Enhancing Vehicle Speed Measurement With Web-Based Camera Integration

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ABSTRACT: *Currently there is a development of speed measuring devices, but the testing process is still lacking ergonomics and safety factors. There are still many Speedometers with no storage of results or less informative printed evidence such as passing information and lack of monitoring aids such as cameras. This research is a development research using the Research and Development (R&D) level 3 method, namely conducting research on existing products and testing the effectiveness of these products. The design of this tool consists of inputs, namely laser sensors, push buttons, batteries, and power supplies. Then the control uses arduino nano and ESP32 with the output of a thermal printer, website, and 20×4 LCD. The performance of the tool is good, works according to the design, and reads well and clearly. The website is valid, works well, and as expected. Camera performance is good enough when connected to a laptop through the DroidCam application. Based on the results of testing the tool using 50 vehicle samples with the results of an average error value of 2.23% or equal to 0.89 km / hour. While the average accuracy or success rate of the measurement results is 97.77%. There are 5 error measurements from 50 vehicle samples or there is 1 error vehicle every 10 measurements.*

KEYWORDS: *Speedometer Tester, Speed, Laser Sensor, Camera, Website.*

I. INTRODUCTION

Transportation is an activity of carrying or transporting goods or passengers from one place to another to meet certain goals driven by humans and machines. Transportation in Indonesia continues to increase every year, especially in motorized vehicles [1]. Based on data from the Korlantas Polri in 2023, the number of motorized vehicles in Indonesia reached 159,077,582 units. This figure is more than in 2022 which reached 148,212,865 million units. The percentage increase in the number of vehicles from 2022 to 2023 amounted to 3.54% of vehicles [2]. As a result, in 2023, traffic accidents reached 147,784 accident cases with a percentage increase of 3.18% from 2022 [3].

In driving, the driver must know how much the speed of the vehicle being driven by looking at the speedometer of the vehicle in order to control the speed of the vehicle that is appropriate on the road being passed. If the vehicle speed indicator does not work, the driver cannot know the speed of the vehicle being driven. There are still many cases of speedometer problems where the vehicle is in a malfunctioning state but no repairs are made which results in road accidents [4].

At this time the speedometer tester tool also has obstacles related to the price of the tool. According to various sources and the results of interviews at the testing site, the price of the speedometer tester itself is very expensive because it uses sensors with high accuracy. In some testing places, the speedometer tester has not been fully carried out due to damage to the tool as well as difficult and expensive maintenance costs [5]. Currently, there is a development of tools to measure speed at an affordable and practical cost, but in the process of testing the tool is still less ergonomic such as too close when testing because the test must be directly adjacent to the wheels of the vehicle or roller speedometer tester which reaches a speed of 40 km / hour. Making tools must maintain occupational health and safety (K3) [6].

On the other hand, there are still testing sites that do not have storage of results and print less informative evidence such as passing or not in writing both on printouts and monitors and also the thresholds listed. After the results are out and printed, the data will be lost. In testing also when there is a problem with the monitor display, the test can be hampered because the speedometer tester does not come out the test results.

There is no integrated vehicle speedometer monitoring tool or the combination of the monitoring system of the vehicle speedometer with the display tool during measurement on one monitor screen. This is less effective due to the limited human resources and vision of the examiner so that the examiner must directly monitor the speed needle pointer on the vehicle and on the other hand the examiner must also press the measurement result command button on the speedometer tester when the speed on the vehicle speedometer is 40 km / hour. This will make the examiner difficult in terms of monitoring the vehicle

Speedometer if the vehicle has large dimensions. If there is a monitoring tool on the vehicle speedometer, the results will be transparent.

Based on these problems, the author wants to design a tool to measure vehicle speed (speedometer) automatically which is practical, efficient, affordable, safe, accurate and modern.

II. THEORY

A. LEGAL BASIS

According to Ministerial Regulation Number 19 of 2021 article 12, roadworthiness requirements testing is carried out by measuring the minimum performance of Motor Vehicles based on roadworthiness thresholds. Based on the roadworthiness threshold, test equipment must be used (Ministerial Regulation No. 19 of 2021) [7]. Roadworthiness requirement testing includes at least:

1) *Exhaust gas emissions including exhaust gas smoke thickness, except for battery electric Motor Vehicles.*
2) *Horn and/or exhaust noise level.*
3) *Main brake capability.*
4) *Parking brake capability.*
5) *Front wheel slip.*
6) *Headlight beam and direction capability.*
7) *Accuracy of speed indicating device.*

According to Government Regulation No. 55/2012 on Vehicles article 72 explains that [8].

1) *The accuracy of the speed indicating device is measured using a speed measuring device at a certain speed that provides the same measurement results between the test equipment and the speed indicating device.*
2) *In the event that the measurement results are not the same as the speed indicating device, a tolerance limit can be given.*
3) *Further provisions concerning specific speeds and tolerance limits shall be regulated by regulation of the minister responsible for road traffic and transportation facilities and infrastructure.*

Regarding the tolerance limit of the speed indicating device, it is regulated in the Decree of the Minister of Transportation Number 63 of 1993 concerning Roadworthiness Thresholds for Motor Vehicles, Carts, Carts, Carriages and Load Bags and their Components article 11, namely the deviation of the speed indicating device is determined by -10% to +15% measured at a speed of 40 km / h or multiples thereof [9].

B. REGULER CIRCULAR MOTION

Angular velocity is the part of the angle that moves from one end to the other in the edge of the circle in a certain unit of time. While linear velocity itself is the speed of movement of an object from one place to another with international units (m / s) but in everyday life using units (km / h) [10].

$$RPS = \frac{n}{t} \quad (1)$$

$$1\ RPS = 60\ RPM \quad (2)$$

$$RPM = \frac{n}{t}\ x\ 60$$

$$RPM = RPS\ x\ 60$$

$$RPS = \frac{RPM}{60}$$

Velocity Formula V(m/s)

$$V = 2\pi r\ x\ (RPS) \quad (3)$$

$$V = \pi\ x\ d\ x\ (RPS)$$

$$V = 2\pi r\ x \frac{RPM}{60}$$

How to convert speed (m/s) to speed (km/h)

$$V = \frac{3600}{1000} xV \quad (4)$$

Description:

V	= Linear Speed(m/s)
RPS	= Revolutions Per Second
RPM	= Revolutions Per Minut
n	= Number of revolutions
t	= Time (s)
r	= Radius of the circle
d	= Diameter

For the calibration of periodic test equipment for motorized vehicles, especially the speedometer tester according to SK DIRJEN NO: KP.1954/AJ502/DRJD/2019 using the following formula:

$$V\ (km/h) = \frac{2\pi r}{1000} x\ RPM\ x\ 60 \quad (5)$$

III. METHODOLOGY (MUST BE)

This research is a development research using the Research and Development (R&D) method. This research and development uses level 3. According to Sugiyono (2015), level 3 itself means conducting research on existing products and testing the effectiveness of these products [11]. In this research and development, namely the improvement and development of previous products so that the results are better, by paying attention to ergonomic factors related to interaction with the work tool and paying attention to occupational health and safety (K3) factors.

A. RESEARCH FLOW CHART

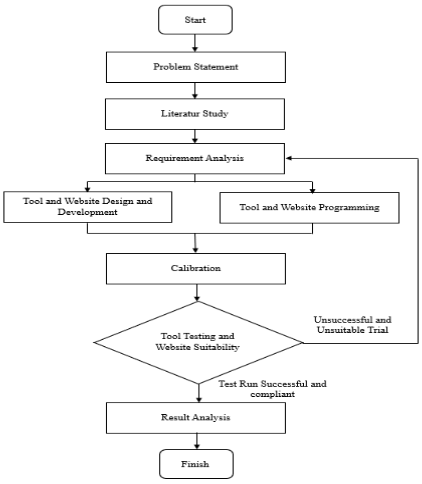


Fig 1. Research Flow Chart

B. BLOCK DIAGRAMS

The design of the system diagram is used to clarify the working principle of the tool made. Below is a block diagram of the tool made.

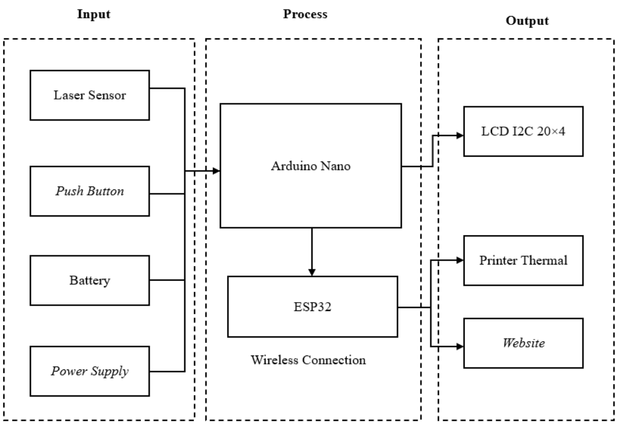


Fig 2. Block Diagram

Explanations related to the components in the block diagram are as follows:

1) *The Laser Sensor is used as a vehicle speed and RPM meter.*
2) *Battery as storing and channeling DC electric current to components without using cables.*
3) *Push button is used as a media controller and work order from the tool.*
4) *Power supply is used to convert high AC electric current into DC electric current needed by components.*
5) *Arduino Nano is used as a process of processing input data from push buttons and laser sensors.*
6) *I2C 20×4 LCD is used as an output displaying the measurement results read by the sensor.*
7) *ESP32 is used as a data distributor via a wifi connection aimed at thermal printers and the Website.*
8) *The thermal printer is used as an output in the form of a hardfile of the sensor reading results.*
9) *The website is used as data input and output in the form of softfiles of sensor readings and monitoring of test results.*

C. ELECTRONIC DESIGN

Electronic design using CorelDRAW 2020 software. Where in CorelDRAW 2020 can be entered components downloaded from the internet or others. In this process, the components are assembled in such a digital way before making a real tool.

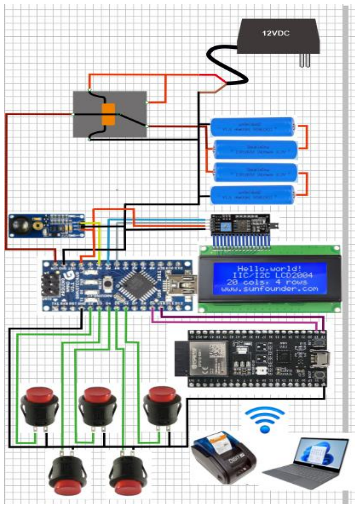


Fig 3. Electronic Design

D. TOOL PROGRAMMING

Making tool programs using Arduino Idea software which can be used to create programs from a system. The program is made in detail according to the needs of the tools used.

E. TOOL DESIGN

In designing the test equipment design using SketchUp 2021 software with a 3-dimensional shape. Then give names according to the components on the tool and colors to make it easier to use the tool.

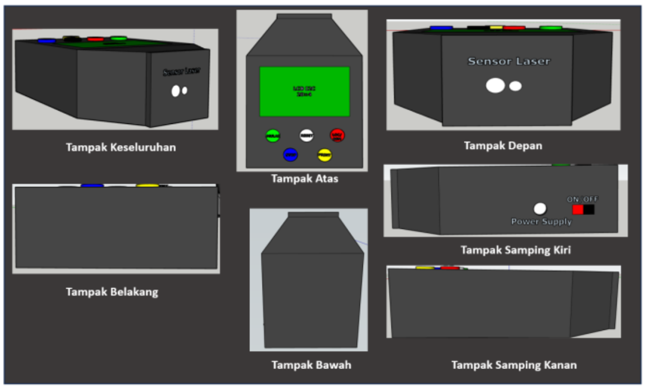


Fig 4. Tool Design

Here's a look at the tool's buttons and their functions:

Fig 5. Tool Button

Description:

1) *20×4 I2C LCD to display measurement results in the form of RPM and speed in Km / hour.*
2) *The green button is “Start” to start the measurement and the laser sensor will measure the rotation of the roller.*
3) *The blue button is “Stop” to stop the measurement when it reaches 40 Km / hour on the vehicle.*
4) *Red button “Loc/Rem” to change online mode or offline mode.*
5) *The white button is “Reset” to make the settings back to the beginning, namely on the vehicle input.*
6) *The yellow button is “Print” to print the results in paper form via a thermal printer.*
7) *On the left there is an ON / OFF switch button to turn on and off the tool design.*

F. *Tool Design*

Website creation uses the help of software or software and also uses a programming language, here are the steps for creating a website [12].

1) *Identify the needs of the website.*
2) *Designing the structure and layout of the page using HTML to determine the basic elements that will be used. HTML is used to create the basic structure of the website.*
3) *Entering code or program through visual studio code software.*
4) *Then apply CSS (Cascading Style Sheets) to enhance the appearance of the website such as color, style and layout of elements.*
5) *Using JavaScript for interactivity to the website.*
6) *Applying PHP (Hypertext Preprocessor) to access, process, and manage data from the database.*
7) *Installing MySQL for database management.*
8) *PHP is also used to display data from the database to HTML pages.*
9) *Testing the website was done using Xampp software offline. To be accessed by many people, web hosting is used.*

G. *How the Design Works*

The following is a schematic of the operation of the speed measuring device on the speedometer tester through the image on SketchUp 2021.

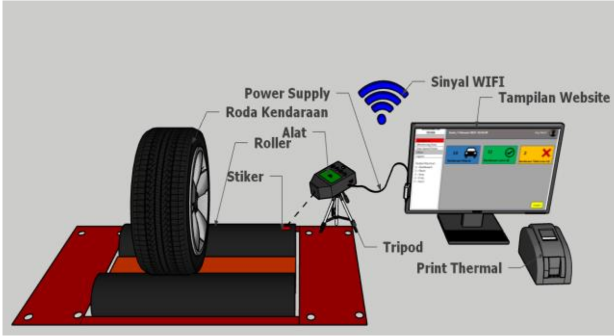


Fig 6. Test Scheme

To find out more clearly about the testing process using a speed measuring device, it can be seen from the following flowchart:

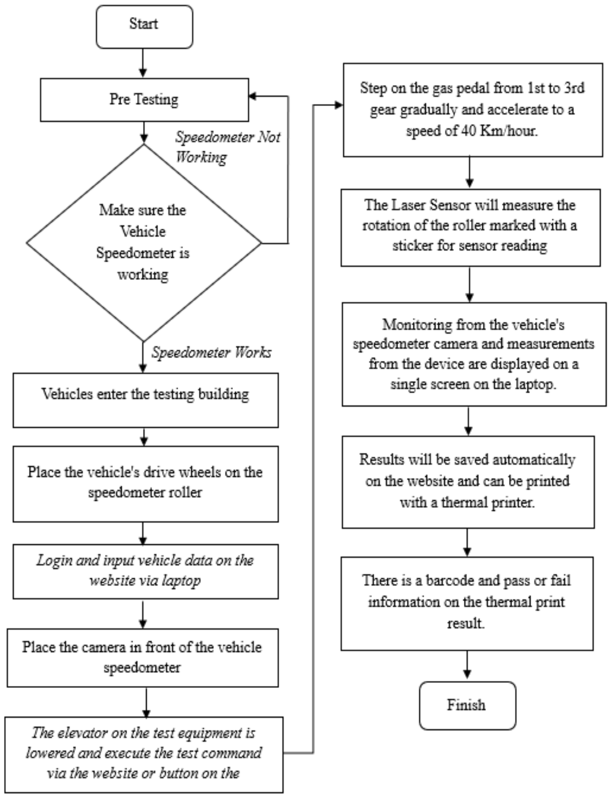


Fig 7. Tool Testing Flowchart

An explanation of the design testing scheme from start to finish as follows:

1) *Before testing, make sure the laptop / PC is connected to the web page and the tool is functioning and ready next to the speedometer roller using a tripod.*
2) *Install a sticker on one of the speedometer tester rollers for reading by the laser sensor.*
3) *The test vehicle enters the testing room and places the rear wheel position on the speedometer roller.*
4) *Before starting, login to the website menu and enter the vehicle data according to the data on the website.*

5) *Place the mobile camera in front of the vehicle speedometer to monitor the speedometer on the vehicle with the tool design on the laptop.*
6) *Press the "Loc/Rem" button for measurement mode can use online mode or offline mode.*
7) *7. After that press the "Start" button to proceed to the test monitoring menu on the web page or display RPM and speed on the tool.*
8) *Lower the speedometer lift and step on the car gas gradually from 1st gear to 3rd gear at a speed of 40 km/h gradually. The laser sensor will measure the rotation of the roller that has been marked with a sticker.*
9) *After 40 km/h, press the "Stop" button/menu to see the last measurement.*
10) *Measurement results on the tool design and vehicle speedometer monitoring can be seen on one screen on a laptop and there is information on whether or not it passes according to the threshold on the website and tool.*
11) *Press the "Print" menu to print the test results via a thermal printer and the measurement data is automatically saved on the website.*
12) *There is pass or fail information and barcode on the speedometer tester test results.*
13) *If you want to repeat again then press the "Reset" button. To repeat the measurement again from the beginning of filling in the data.*

IV. RESULTS AND DISCUSSION

A. *TOOL COMPONENT ASSEMBLY*

The design and manufacture of tool design consists of assembling tool components, programming tools, creating websites, and working principles of tools. The following are the stages of designing and making tool designs.

1) *Preparation of Tools and Materials*

The preparation of tools and materials includes the preparation of input, output and processor components. Input components include laser sensors, push buttons, batteries, power suplly. In the processor component, researchers use arduino nano and ESP32 and for output components including 20×4 I2C LCD, thermal printer and website.

2) *Laser Sensor Assembly*

The laser sensor is used to measure the speed of the speedometer roller rotation. The laser sensor measures the rotation of the roller marked with a sticker [13] [14]. The following are the steps to attach the laser sensor to the Arduino nano and ESP32 with a PCB board.

Fig 8. Sensor Laser Assembly

3) *20 x 4 I2C LCD Assembly*

The LCD functions to display text from the arduino nano programming in the form of the beginning of the operation of the tool, measurements, and the results of measurements by the tool [15] [16]. The following are the steps to install the LCD pin using a connecting socket to the arduino nano port with PCB.

Fig 9. 20x4 I2C LCD Assembly

4) *Installation of ESP32 and Arduino Nano Module*

ESP32 is used as a data receiver from Arduino nano and then sent via bluetooth serial which is connected to a thermal printer and website [17] [18] [19]. The following are the steps for installing the ESP32 module with a PCB board.

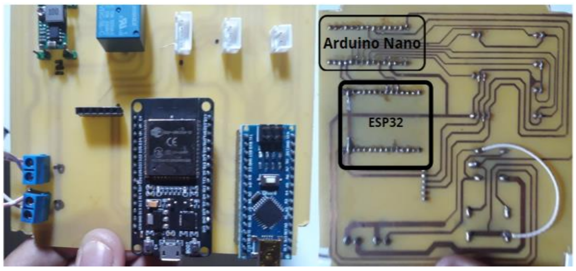


Fig 10. Installation of ESP32 Module

5) *Assembly of Push Button, Battery, and Power Supply*

The push button is used to execute commands on the tool, while the battery to provide electric current without being directly connected to the electric current by utilizing the power from the battery as well as power supply that is directly connected to the electricity [20]. The following are the assembly steps.

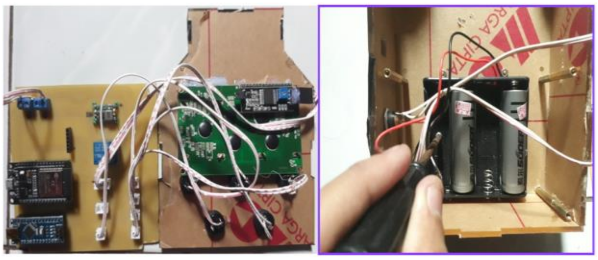


Fig 11. Assembly of Push Button, Battery, and Power Supply

6) Installation of the Electrical Circuit on the Container Interior

The assembled components are then installed on the interior of the container that has been made. The circuit located in the container is attached to the base of the container so that it sticks firmly and there is no chaos when the tool is moved. There is a stepdown to stabilize the voltage [21]. The installation of relays will shorten the circuit and make the electric current not much reduced. The electric current will be channeled maximally to the components [22].

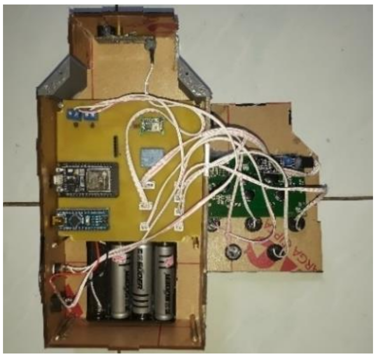


Fig 12. Installation of the Electrical Circuit on the Container Interior

7) Installation of Components on the Exterior off the Container

The visible components include the laser sensor, 20×4 I2C LCD, push button, power supply cable, battery compartment and ON/OFF switch button. The visible components are placed on the exterior of the container according to the holes made based on the previous design and the holes are made based on the size of the components.

Fig 13. Installation of Components on the Exterior of the Container

8) Final Result of the Tool

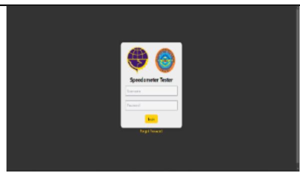
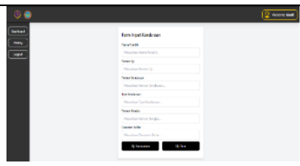
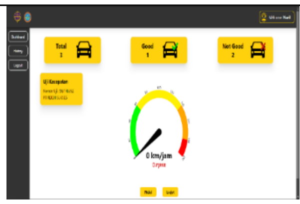
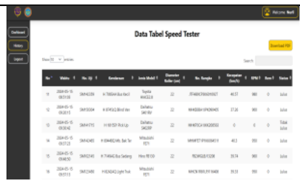
After carrying out several stages of assembling components and assembling the container so that a device is formed that is ready to enter the program to operate the device made. The following is the finished form of a tool that is connected to a thermal printer and website via an ESP32 module. there is a thermal printer to print test results [23].

Fig 14. Final Result of the Tool

B. Website Display

The following is the appearance of a website that has been created via Xampp, Visual Studio Code, and can be accessed by the public [24] [25].

Tbl 1. Website Display

Website Display	Content
	Page to enter the website
	Vehicle data entry page
	Tool measurement page
	Test result page
	PDF download page
	Data of the vehicle that conducted the speedometer tester test

C. Tool Design Calibration

Calibration of the tool design aims to determine the accuracy of the laser sensor reading in reading the roller rotation. The speed used is from 5 km / h to 40 km / h with a multiple of 5 km / h. After the calibration is complete, proceed with testing the existing KBWU with various types of vehicles [26] [27]. After the calibration has been completed, proceed with testing the existing KBWU with various types of vehicles. The following are the steps that must be taken before taking object measurements.

1) Function Check

A) Check the condition of the power supply cable in good condition and connected to the source of electricity.

B) Rotate the roller and check the function indicator shows the rotation speed value.

C) Make sure the indicator shows zero when the roller is stationary or not moving.

D) If all elements have been fulfilled, the tool design is ready to take measurements.

2) Measurement

A) Measure the circumference of the roller (k) in units of (cm) using a meter and calculate the diameter of the roller.

Fig 15. Roller Measurement

B) Determine the measuring point on the edge of the roller to install the measuring point using sticker media or other media that can be read by the tool design and is different from the roller color [25].

Fig 16. Tachometer

C) Use the KBWU vehicle that is conducting the test to rotate the roller at a predetermined speed [28].

Fig 17. Innova Car

D) Observe and record the measurement results indicated on the tool design and tachometer (calibrator).

Fig 18. Tool and Tachometer Result

E) Tool Calibration against Tachometer

The brand / type of vehicle used is an Innova car made in 2006 with the circumference of the speedometer tester roller in the PKB laboratory at PKTJ campus 1, which is 99 cm [29] [30]. The following is the calibration data for the RPM and km/h values on the tool design .

Tbl 1. Writing Table Two Columns

Vehicle Speed (Km/h)	Tacho (RPM)	Tacho Conversion (Km/h)	Tool RPM (RPM)	Vehicle Speed (Km/h)	Error (%)	Accuracy (%)
5	72,8	4,32	70,42	4,18	2,81	97,19
10	177,7	10,56	182,37	10,83	2,56	97,44
15	282,8	16,80	273,97	16,27	3,22	96,78

Vehicle Speed (Km/h)	Tacho (RPM)	Tacho Conversion (Km/h)	Tool RPM (RPM)	Vehicle Speed (Km/h)	Error (%)	Accuracy (%)
20	368,4	21,88	361,45	21,47	1,92	98,08
25	429,6	25,52	408,16	24,24	4,17	95,83
30	497,5	29,55	483,87	28,74	2,82	97,18
35	612,6	36,39	625,00	37,13	1,98	98,02
40	691,3	41,06	681,82	40,5	1,39	98,61
Ave	***390,99***	***23,23***	***385,88***	***22,92***	***2,61***	***97,93***

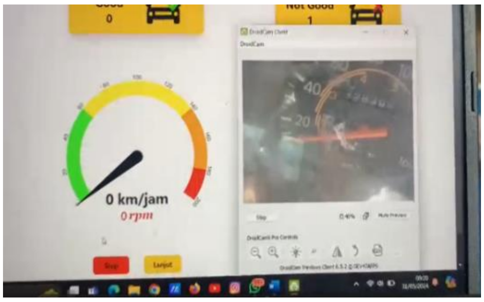


Fig 19. Monitoring Result of The Droidcam App

From eight trials, it is known that the average error value obtained from the difference in the RPM value of the tool design with a calibration tool in the form of a tachometer is 2.61% with an accuracy of 97.39%. While the average error value obtained from the difference in the speed value of the design tool with a calibration tool in the form of a tachometer is 2.61% with an accuracy of 97.39%.

D. Testing On KBWU

Fig 20. Tool Design

At this stage the researchers conducted a comparison test of the measurement results on the speedometer tester in the Semarang City motor vehicle testing with the design of the tool using 50 vehicle samples. The following is the tool testing data with KBWU.

Tbl 2. Calibration Result

No	Brand/type	Speedometer Tester (Km/h)	Tool Design (Km/h)	Difference (Km/h)	Error (%)	Accuracy (%)
1.	Mitsubishi TRITON 2.4L	40,6	40,15	0,45	1,12	98,88
2.	Isuzu PHR54UCAYIN1	38,5	39,74	1,24	3,12	96,88
3.	Toyota HIACE 2.8	41,4	40,57	0,83	2,05	97,95
4.	Daihatsu S401RV	36,8	37,26	0,46	1,23	98,77
5.	Daihatsu S402RP	0	0	0	0	0
6.	Mitsubishi FE71	39,4	40,3	0,9	2,23	97,77
7.	Hino FB130	40,7	39,74	0,96	2,42	97,58
8.	Mitsubishi FE71	39,8	39,33	0,47	1,20	98,80
9.	Mitsubishi FE84G	40,3	40,98	0,68	1,66	98,34
10.	Hino WU342/130HD	40,8	41,40	0,6	1,45	98,55
11.	Daihatsu S89	38,6	37,26	1,34	3,60	96,40

No	Brand/type	Speedometer Tester (Km/h)	Tool Design (Km/h)	Difference (Km/h)	Error (%)	Accuracy (%)
12.	Mitsubishi TRITON 2.5SC	40,5	39,74	0,76	1,91	98,09
13.	Isuzu PHR54UCAAIN1	0	0	0	0	0
14.	Isuzu NLR55B	39,6	40,39	0,79	1,96	98,04
15.	Hino XZU309R	39,3	38,50	0,8	2,08	97,92
16.	Hino WU342	40,9	40,15	0,75	1,87	98,13
17.	Isuzu NLR85U	40,4	39,74	0,66	1,66	98,34
18.	Mitsubishi FE73MT	40,6	39,74	0,86	2,16	97,84
19.	Mitsubishi FE71L	40,4	39,74	0,66	1,66	98,34
20	Hino WU342R	41,4	40,57	0,83	2,05	97,95
21.	Suzuki ST150	35,1	35,60	0,5	1,40	98,60
22.	Mitsubishi TRITON2.4LDC	41,9	40,57	1,33	3,28	96,72
23.	Mitsubishi L300DP	40,3	39,33	0,97	2,47	97,53
24.	Suzuki GC415	39,8	38,91	0,89	2,29	97,71
25.	Hino WU342R	41,1	40,15	0,95	2,37	97,63
26.	Mitsubishi FE74N	40,4	39,74	0,66	1,66	98,34
27.	Mitsubishi FE74HDV	41	39,74	1,26	3,17	96,83
28.	Daihatsu S402RP	0	0	0	0	0
29.	Mitsubishi FE71	39,8	40,98	1,18	2,88	97,12
30.	Mitsubishi TRITON2.4LDC	42,2	41,4	0,8	1,93	98,07
31.	Suzuki GC415	40,6	39,70	0,9	2,27	97,73
32.	Wuling FORMO 1.2BV	39,3	38,08	1,22	3,20	96,80
33.	Isuzu HR54UCAAIN1	42,8	41,40	1,4	3,38	96,62
34.	Daihatsu S401RV	38,7	38,08	0,62	1,63	98,37
35.	Toyota HIACE M/T	40,3	39,74	0,56	1,41	98,59
36.	Daihatsu S401	0	0	0	0	0
37.	Mitsubishi FE71MT	39,8	38,91	0,89	2,29	97,71
38.	Hino XZU349R	42,1	40,98	1,12	2,73	97,27
39.	Daihatsu S401RP	36,9	38,08	1,18	3,10	96,90
40.	Mitsubishi L300 PU	40,5	39,33	1,17	2,97	97,03
41.	Toyota HILUX 2.4V	40,4	39,74	0,66	1,66	98,34
42.	Isuzu NQR81U	40,9	39,74	1,16	2,92	97,08
43.	Toyota HIACE 2.8	41,5	40,39	1,11	2,75	97,25

No	Brand/type	Speedometer Tester (Km/h)	Tool Design (Km/h)	Difference (Km/h)	Error (%)	Accuracy (%)
44.	Mitsubishi FE74HDK	0	0	0	0	0
45.	Mitsubishi FE84G	40,6	39,74	0,86	2,16	97,84
46.	Daihatsu S401RV	39,6	40,57	0,97	2,39	97,61
47.	Mitsubishi FE74	40,9	39,74	1,16	2,92	97,08
48.	Isuzu PHR54CBB	35,9	35,60	0,30	0,84	99,16
49.	Hino 130HDL	42,9	42,22	0,68	1,61	98,39
50.	Hino 130	41,8	40,57	1,23	3,03	96,97
	Rata - Rata	***40,12***	***39,71***	***0,88***	***2,23***	***97,77***

Tbl 3 shows the results of measuring vehicle speed using a speedometer tester with a tool design that can be seen with the graph below.

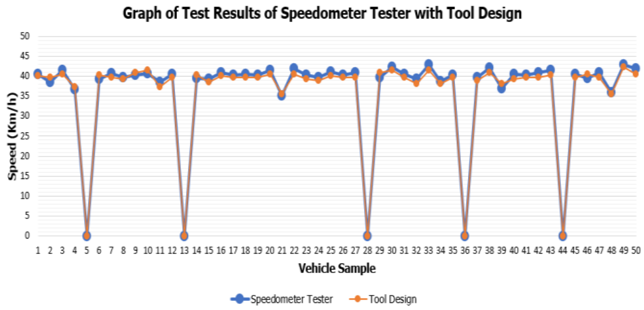


Fig 21. Graph of Test Result

The performance of the tool design is good and works according to design. Evident in the graph above with 50 samples can be explained that the average measurement difference is 0.88 km / hour. The highest difference in speed measurement results between the speedometer tester and the tool design is on the Isuzu HR54UCAAIN1 Pick Up Box vehicle at the 33rd measurement with a speed difference of 1.4 km / h, an error value of 3.38% and an accuracy of 96.62%. While the lowest difference is found in the Pick Up Box Isuzu PHR54CBB at the 48th measurement with a speed difference of 0.3 km / h, an error value of 0.84% and an accuracy of 99.16%.

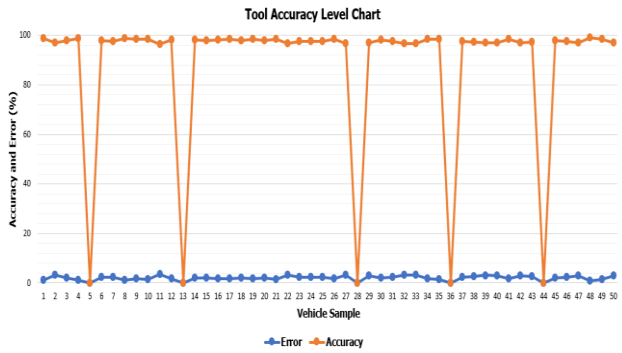


Fig 22. Tool Accuracy

The average error value between the speedometer tester and the tool design is 2.23% or equal to 0.89 km/hour. While the average accuracy or success rate of 50 vehicle samples is 97.77%. Of the 50 vehicle samples, there were 5 vehicles that were not read or errors by the design tool. Data collection was carried out for 5 days with 10 samples of mandatory motorized vehicles each day. Error results occur every time data collection 10 samples there is 1 sample with error results.

V. CONCLUSION

Based on the description of the design, manufacture, and testing and discussion of the results of the Design of a Website-Based Vehicle Speed Measurement Tool with Camera Integration, it can be concluded, among others.

1) *The design and design of a website-based vehicle speed measuring device with camera integration consists of input in the form of a laser sensor. Then the control process is Arduino nano and ESP32. Output in the form of a 20×4 LCD, thermal printer, and website. There is also a camera tool to record vehicle speedometer measurements connected to a laptop. LCD and website display in the form of RPM and speed (km / h).*
2) *The performance of the device is good, it reads well and is in accordance with the formula. Still has measurement error when measuring on KBWU. The website is valid, works well, and as expected. Camera performance is good enough when connected to a laptop through the DroidCam application. There is a delay between the website speedometer and the vehicle speedometer video and the camera installation is still not effective because the installation takes a long time, the internet connection must be good and there are still frequent advertisements in the application.*
3) *The measurement results of the design of a website-based vehicle speed measuring device with camera integration using 50 vehicle samples with an average error value of 2.23% or equal to 0.89 km / hour. While the average accuracy or success rate of the measurement results is 97.77%. There are 5 error measurements from 50 vehicle samples or there is 1 error vehicle every 10 measurements.*

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