

DESIGN AND DEVELOPMENT OF ARDUINO MEGA-BASED VEHICLE DIMENSION MEASUREMENT TOOL

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ABSTRACT

The measurement of the dimensions of a motorized vehicle is sometimes not carried out correctly and according to the measurement procedure which results in a size difference between the sizes listed on the Type Test Registration Certificate (SRUT) and the results of measurements in the field. The difference in size can result in the vehicle exceeding the specified dimensions or commonly referred to as over dimension and over loading (ODOL) conditions. The over-dimensional and over-loading (ODOL) vehicles will result in state losses in the form of road repair costs due to over-loading violations and/or over-size violations and result in an increase in the potential for traffic accidents due to over-dimensional and over-loading. One of the causes of errors in the process of measuring the dimensions of motorized vehicles is the process of measuring dimensions which are still done manually by motorized vehicle testers using a roll meter. These manual measurements are sometimes not carried out exactly at the measuring point and according to the size point of view so that the measurement results will be different from what they should be.

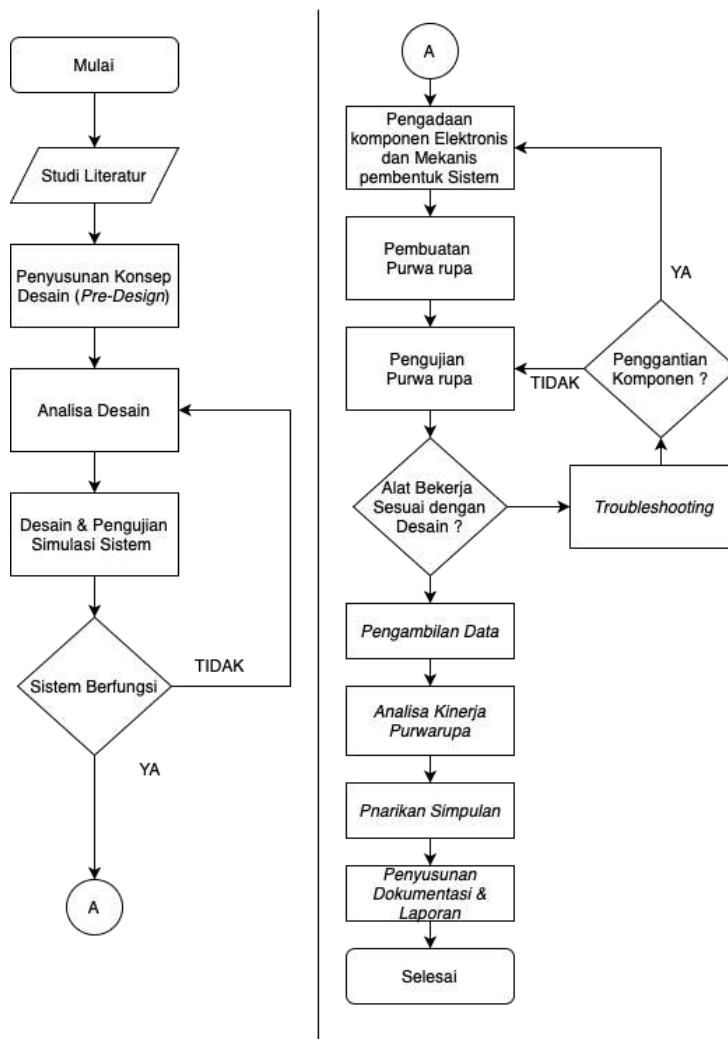
Keywords: arduino mega; dimensions; measuring instruments; odol; vehicles

INTRODUCTION

The implementation of periodic testing of motorized vehicles as stipulated in the Minister of Transportation Regulation Number 133 of 2015 Article 8 consists of checking the technical requirements of motorized vehicles, testing the roadworthiness of motorized vehicles, and issuing motorized vehicle test pass marks. One of the check items for the technical requirements of motorized vehicles that must be carried out is the measurement of the dimensions of motorized vehicles which include vehicle height, vehicle width, vehicle length, axle distance, rear overhang (ROH), front overhang (FOH).), and angle goes.

The measurement of the dimensions of motorized vehicles is sometimes not carried out correctly and in accordance with the measurement procedure which results in a difference in size between the size stated on the Type Test Registration Certificate (SRUT) and the measurement results in the field. The size difference can result in the vehicle exceeding the specified or usual dimensions called over dimension and over loading (ODOL) conditions. These over-dimensional and over-loading (ODOL) vehicles will result in state losses in the form of financing road repairs due to overloading and/or over-size violations and result in an increase in the potential for traffic accidents due to ODOL. One of the causes of errors in the process of measuring motorized vehicle dimensions is the dimension measurement process which is still carried out manually by motorized vehicle testers using a roll meter. These manual measurements are sometimes not carried out precisely at the measuring point and according to the size point of view so that the measurement results will be different from what they should be.

METHOD



This type of research is applied research which refers to problem solving experimentally with coherent and systematic stages while these stages are described in the research flowchart as shown in the following figure.

Figure 1. Research Flowchart

RESULTS

Whole System Electronic Circuit

All parts of the sub-system are assembled into a complete system so that the overall circuit schematic arrangement is obtained as shown in the following figure:

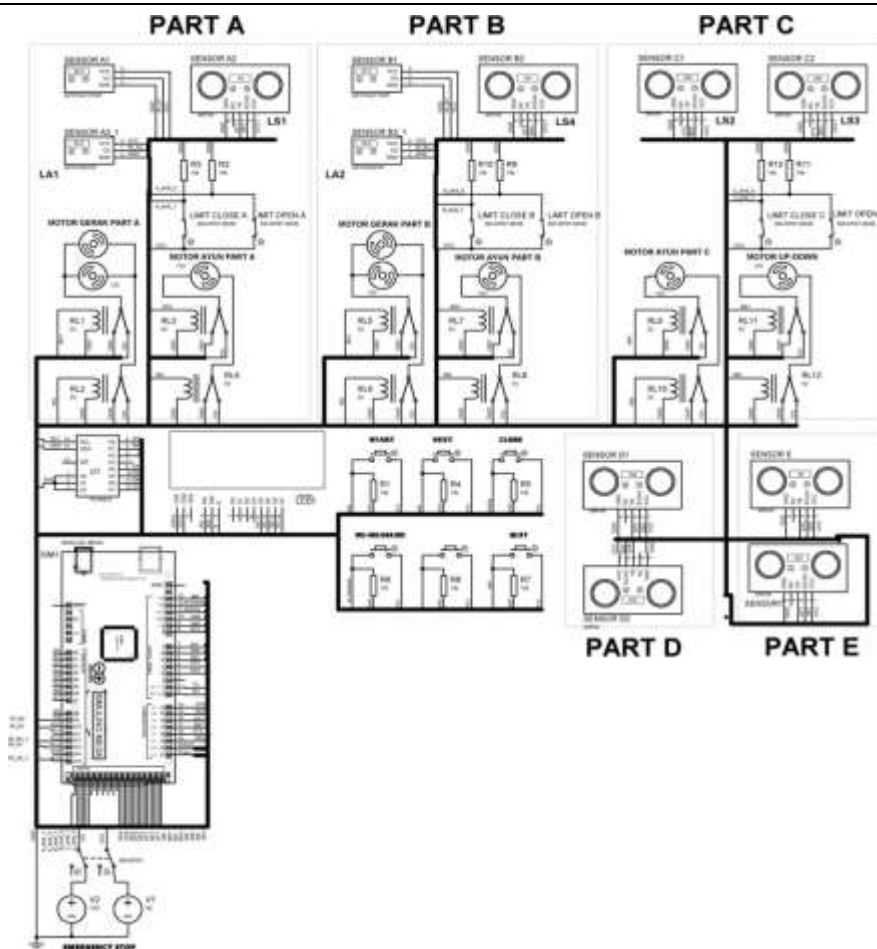
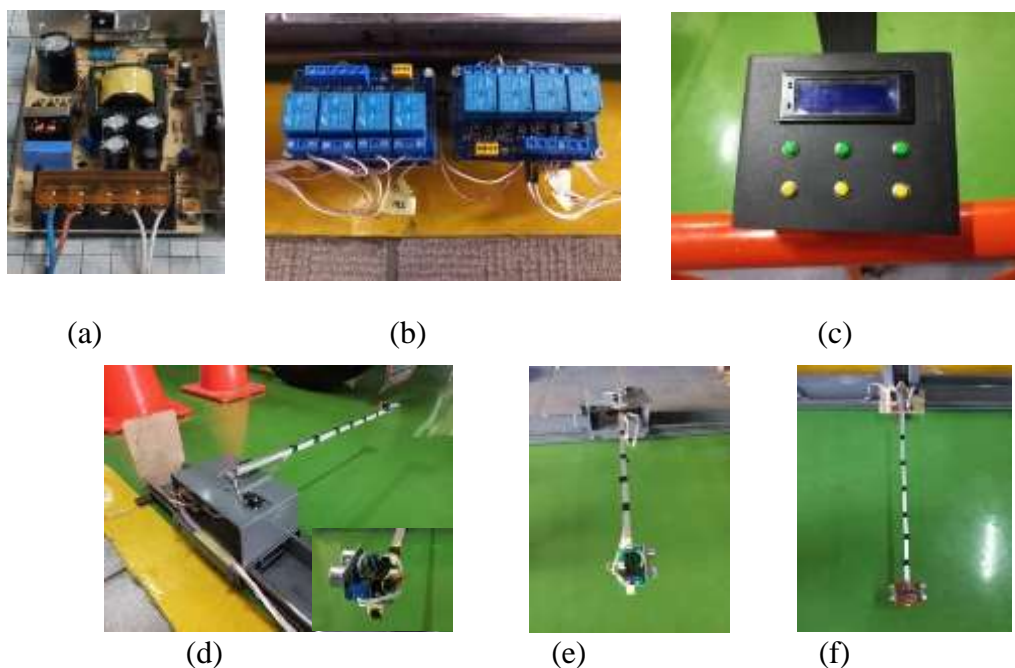


Figure 2. Overall circuit schematic

Figure skematik/wiring the diagram above is then used as a reference in the stages of installation and installation of the electronic components forming the system so that the results of the installation of hardware components for each part (sub-system) are obtained as shown in the following figure.



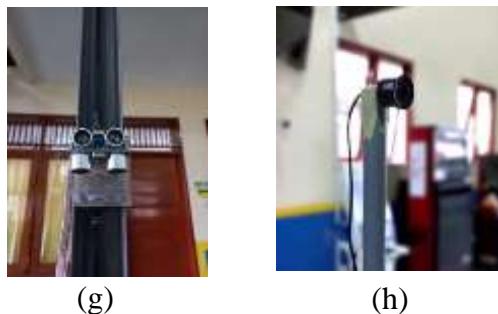


Figure 3. Component Installation Image for Each Part (Sub-System);
(a) Power Supply; (b) Module Relays; (c) Push Button Arrays; (d) Part A; (e) Part B; (f) Part C; (g) Part D; (h) Part E.

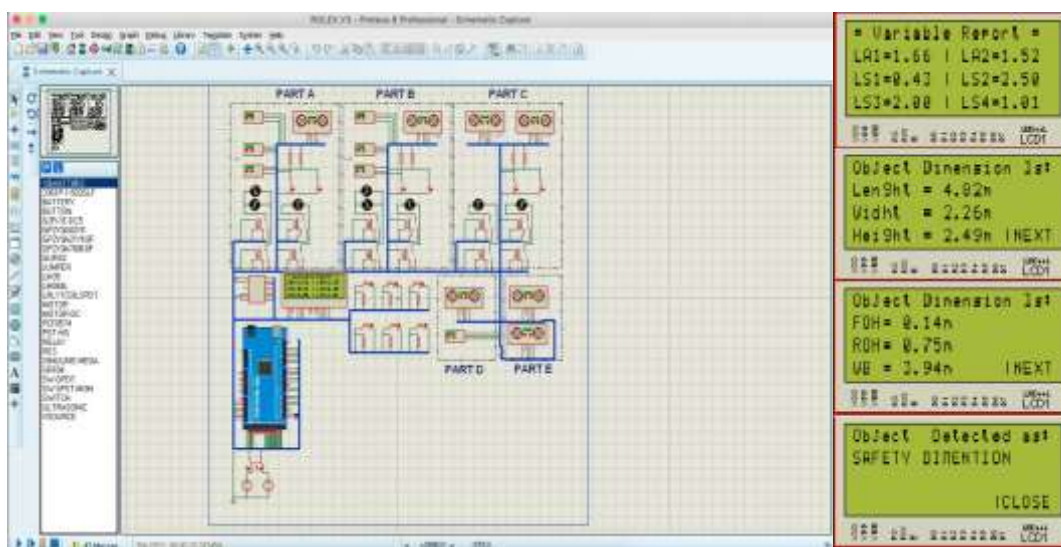


Figure 4. Simulation Results

Through the simulation results, it can be obtained that the designed system is functioning as expected where the system is able to detect measuring objects, perform measurements, compute and provide recommendations for measuring results.

Calibration and Adjustment

The calibration and adjustment process is carried out before taking real measurements using a prototype measuring instrument designed to obtain accurate measurement results. The calibration process includes calibration for all types of sensors used to measure the length, width and height of the vehicle, while FOH, ROH and Wheel Base are not calibrated directly because the measurement values are obtained from a program computational process derived from sensor readings.

Technically, calibration is carried out by comparing sensor readings with a standard that is traceable to national and international standards in the form of measuring instruments meter with a resolution in milli meters (mm). The results obtained are as follows:

Table 1.
 Calibration Data Table

No	Jenis Sensor	Ukuran Sebenarnya	Bacaan Sensor	Penyimpangan
1	LiDaR GP2Y0A21YK0F	500	530 mm	30 mm
2	LiDaR GP2Y0A02YK	500	542 mm	42 mm
3	Omni- directional Ultrasonic	500	512 mm	12 mm

Light Supply Testing

The test procedure is carried out by measuring the nominal voltage under open circuit conditions or without load or under load conditions using a digital multimeter. The results of the voltage measurements are presented in the following table:

Table 2.
 Power Supply Testing

Kondisi Pembebanan	Tegangan yang dibutuhkan	Hasil Pengukuran	Penyimpangan
Tanpa beban (<i>Open Circuit</i>)	5V	5,09 V	1,8 %
Dengan beban (<i>On-Load</i>)	5V	4,98 V	0,4 %

Hasil pengujian di atas dapat dilihat penyimpangan tegangan rangkaian *power supply* dalam kondisi tanpa beban adalah senilai 0,09V atau 1,8% dan pada kondisi dengan beban adalah senilai 0,02 V atau 0,4%, sehingga tegangan catu dari rangkaian *power supply* masih dapat dikatakan stabil dan mampu memenuhi kebutuhan tegangan sistem secara keseluruhan.

Relay Module Testing

Relay testing is carried out to test the function of the relay as an electronic switch to regulate the activation and change the direction of rotation of the moving part motor that allows the use of external power so that the logic output in the form of an electric voltage between 0 and 5V from the microcontroller is not directly connected to the sub-system and does not provide a load. overcurrent on the microcontroller. The relay used is a positive trigger type 5VDC single pole dual throw (SPDT) with a maximum rating of 30V/10A. The measurement results are shown in the following table.

Tabel 3.
 Pengujian Catu Daya/Power Supply

No	Re la y	Input Trigger		Tegangan Output		Arah Putaran Motor
		Triger 1	Triger 2	Pole 1	Pole 2	
1	Motor Gerak Part A	1	0	4,94V	0V	<i>Clockwise</i>
		0	1	0V	4,96V	<i>Counter Clockwise</i>
2	Motor Ayun Part A	1	0	4,94V	0V	<i>Clockwise</i>
		0	1	0V	4,96V	<i>Counter Clockwise</i>

3	Motor Gerak Part B	1	0	4,94V	0V	<i>Clockwise</i>
		0	1	0V	4,96V	<i>Counter Clockwise</i>
4	Motor Ayun Part B	1	0	4,94V	0V	<i>Clockwise</i>
		0	1	0V	4,96V	<i>Counter Clockwise</i>
5	Motor Ayun Part C	1	0	4,94V	0V	<i>Clockwise</i>
		0	1	0V	4,96V	<i>Counter Clockwise</i>
6	Motor Gerak Part D	1	0	4,93V	0V	<i>Clockwise</i>
		0	1	0V	4,93V	<i>Counter Clockwise</i>

Through the test results in the table above it can be seen that all relays in the module will conduct a source voltage according to the trigger voltage through logic operations on each trigger input pin to the pole relay pin where if pole 1 receives a voltage of 5VDC, the motor will rotate clockwise (to right direction) whereas if pole 2 receive 5VDC voltage then the motor will rotate counterclockwise (to the left), this shows the function and role of the relay module can run properly according to the design intent and purpose.

Push Button Array Testing

Testing the Push button array is carried out to test the performance of the push button as a logic command button that is used as an input command for the microcontroller, the test procedure is to measure the output voltage of the push button when it is pressed or not.

Table 4.
 Push Button Array Testing

No	Push Button	Tegangan Keluaran		Keluaran Logika	
		Kondisi Tekan	Kondisi bebas	Kondisi Tekan	Kondisi bebas
1	Start	4,85 V	0V	1	0
2	Next	4,85 V	0V	1	0
3	Close	4,84 V	0V	1	0
4	Re-Measure	4,85 V	0V	1	0
5	Quit	4,86 V	0V	1	0

Through the test results shown in the table above, it can be ascertained that the output voltage of the push button array can operate in accordance with the logic principle, where for each type of push button it will transmit an average voltage of 4.85V when pressed and do not continue the voltage in free or not pressed. The resulting output voltage of 4.85V can be said to be ideal for meeting the needs of logic 1 in the CMOS circuit

Dimensional Measurement Tool Reader Test

The measuring object consists of 3 vehicles to test the accuracy of the measurements and each vehicle is measured 10 times each to see the precision of the dimensional measuring device designed with the measurement results shown in the following table:

Table 5.
 Dimensional reading test

No.	Measuring Vehicle Type Dimensions	Dimen sion Type	Standard Values (Mm)	5% Δ STD	MEASUREMENT RESULT (Mm)										Measurement Average	Δ (Standard Value - Average Measurement)	% Accuracy	Measur ement Deviation
					1	2	3	4	5	6	7	8	9	10				
1	Toyota InnovaReborn (DK 1025 K)	Long	4735	237	4688	4678	4601	4621	4536	4528	4612	4494	4545	4552	4585,5	149,5	96,84%	3,16%
		Wide	1830	92	1810	1812	1790	1695	1694	1588	1594	1690	1896	1887	1745,6	84,4	95,39%	4,61%
		Tall	1795	90	1880	1890	1870	1882	1882	1780	1782	1781	1680	1880	1830,7	35,7	98,01%	1,99%
		WB	2750	138	2935	2835	2835	2837	2835	2645	2645	2533	2432	2489	2702,1	47,9	98,26%	1,74%
		FOH	1000	50	959	959	959	959	959	959	959	959	959	959	959,0	41,0	95,90%	4,10%
		SPIRIT	1000	50	970	962	962	962	962	962	962	962	962	962	962,8	37,2	96,28%	3,72%
2	Toyota Vios 2006 (DK 102K)	Long	4285	214	4120	4120	4120	4120	4120	4120	4120	4120	4120	4120,0	165,0	96,15%	3,85%	
		Wide	1695	85	1635	1635	1635	1635	1635	1635	1635	1635	1635	1635,0	60,0	96,46%	3,54%	
		Tall	1450	73	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430,0	20,0	98,62%	1,38%	
		WB	2550	128	2445	2445	2445	2445	2445	2445	2445	2445	2445	2445,0	105,0	95,88%	4,12%	
		FOH	700	35	687	686	685	658	658	656	688	688	688	688	678,2	21,8	96,89%	3,11%
		SPIRIT	950	48	930	930	930	930	930	930	930	930	930	930	930,0	20,0	97,89%	2,11%
3	Toyota Innova2010 (DK 716K)	Long	4555	228	4487	4486	4490	4490	4580	4488	4487	4485	4492	4390	4487,5	67,5	98,52%	1,48%
		Wide	1770	89	1710	1710	1710	1710	1710	1710	1710	1710	1710	1710	1710,0	60,0	96,61%	3,39%
		Tall	1750	88	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695,0	55,0	96,86%	3,14%
		WB	2750	138	2680	2680	2680	2680	2680	2680	2680	2680	2680	2680	2680,0	70,0	97,45%	2,55%
		FOH	830	42	805	805	805	805	805	805	805	805	805	805	805,0	25,0	96,99%	3,01%
		SPIRIT	960	48	948	943	944	943	942	940	938	936	935	933	940,2	19,8	97,94%	2,06%

Referring In the description above, a relationship curve can be obtained between accuracy values for all dimensional parameters as shown in the following figure:

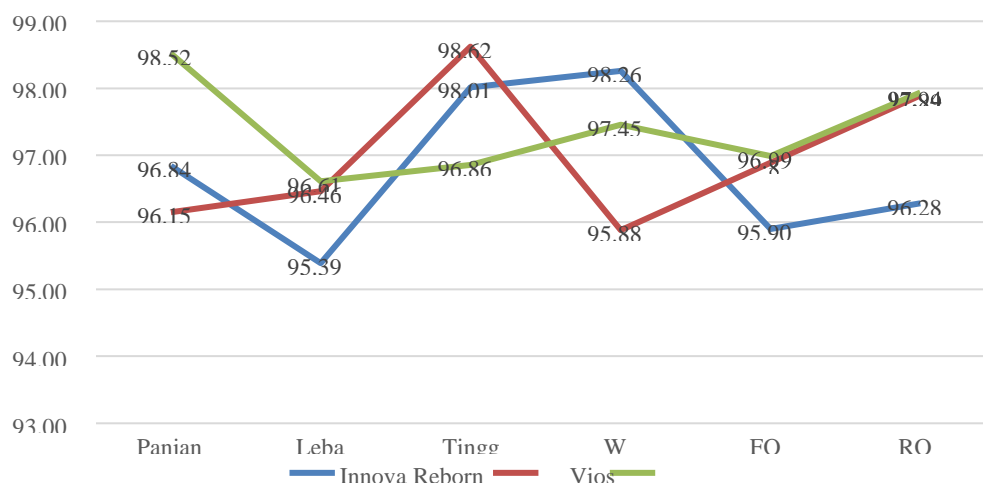


Figure 5. Curve Correlation Between Accuracy Values and Dimensional Parameters

From the graph above it can be seen that the accuracy of the designed dimensional measuring instrument is in the range of 95.39% to 98.62%.

DISCUSSION

The results of the design through subsequent design are modeled in the form of a simulation circuit/module with the help of Proteus 8 computer software. The aim is to virtually test the design results series to observe the system response in the form of visualization of motor rotation, sensor reading results and program computations to get readings of dimensional measuring instruments. other than that with the existence of a simulation can minimize the risk of damage to electronic components when the designed measuring instrument malfunctions due

to program errors or cable wiring.

Through the calibration process data for each type of sensor shown in the table above, it can be obtained that the reading deviation of the LiDaR GP2Y0A21YK0F sensor which is enabled for variable length measurement is 30 mm, for the GP2Y0A02YK LiDaR sensor is 42 mm and for Omni-directional Ultrasonic is 12 mm. If it is observed that the readings of all sensors are greater than the actual value, the adjustment process is carried out by applying a reduction operation equal to the deviation value in the program code for each computation.

CONCLUSION

The design of a vehicle dimension measuring device using an Arduino Megan 2560 microcontroller control device using an omnidirectional ultrasonic sensor SRF05, LiDaR GP2Y0A21YK0F and GP2Y0A02YK has been carried out. Methods and research processes are carried out through coherent stages starting from theoretical studies, drafting concepts, design processes and troubleshooting to analysis and drawing conclusions. Through this research, it can be obtained that the maximum accuracy level of tool measurement is 98.62%. System testing shows results that are in accordance with the design by not exceeding the desired minimum tolerance limit of 5%.

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