ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 9, September 2019

Monitoring System and Control of University of Jember Electric Vehicle Based on Radio Frequency

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ABSTRACT: Electric vehicle is one choice to developed clean pollution countries. In this research a electric vehicle is monitor and control to get best performance of University of Jember electric vehicle. The voltage sensor, current sensor, speed sensor, and dynamic characteristic testing with control mode and driver mode. In the control mode test, there are four road condition that is straight road, turn road, down road, and ramp. In these test, the high current value happen in the 7.93 A. In the speed control mode, the electric vehicle runs well on the road condition straight value reference speed is of 250 RPM. In the condition of the turning road with the speed of reference is 250 RPM, the average velocity value is of 245.79 RPM, and in the decrease elevation of road, the velocity value is 206.55 rpm, and finally for increase elevation of road, the speed is 99.63 rpm. All of this numerical can show on master control, because all of parameter send by radio frequency of the system. These results have low error and have high accuracy.

KEYWORDS: electric vehicle, monitoring, control, radio frequency

I.INTRODUCTION

Nowdays, the oil-fuel vehicles become a basic requirement for the large community. The role of the vehicles is very significant for goods transportation and persons mobility, for work purposes, for travel and others. But unwittingly, increase of car demand, also increas the dangerous of human survival. Principal points of such threats is the air pollution on the Earth. Therefore, much of the research done to develop electric cars, so the air pollution can eliminate, keeping in mind that electric cars do not produce pollution.

In an effort to participation to get solutions of the electric vehicle problems, the University of Jember electric car team have some researches. One of these researches is get solution of the problem on control process and measurement of voltage or current that electric vehicles consumed. Normally, the control and measurement of current or voltage is done manually and must be directly related to the object. This cause the process become longer and less efficient. So it needed a system to be able to remote control and measurement. Measurement have been build in electric vehicle [1-2], but this research not use remote control and measurement.

In this research, radio frequency used as monitoring media and control of voltage, current, and reading of electric energy, and these data send to personal computer. The system design of hardware and sofware of how the radio frequency use to monitoring and control is the heart of this article, while data analysis of result monitoring depend of user, but these data had been on computer memories.

The abstract of this article published on International Conference On Smart Green Technology (ICSGT) 2018 https://www.bioleagues.com › downloads › book › ICSGT-Book

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II.DESIGN OF THE SYSTEM

Block diagram of design of the systems can be seen in Figure 1. There are some sensor. Voltage sensor is used as input or the tools to enter data from the voltage reading of the measured voltage. Sensors current (*Shunt Resistor*) used to flow toward the load (for example: 0-5 A) is converted into a voltage 0-5 Volt [3]. Because this flow sensor used to detect the current flows toward the load, then the coil is designed to be connected in series with the channel.

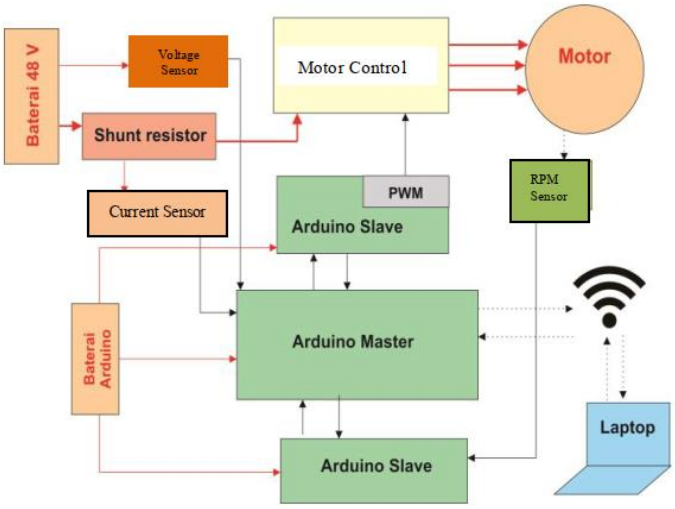

Fig. 1 Block diagram

In this system, the microcontroller used in the form of Atmega 328P (Arduino UNO R3) with 22 line i/o, 32 KB flash memory, 6 channel PWM, 8 channel 10-bit ADC, 2 channel Timer/Counter 1 8-bit channel Timer/Counter, 16-bit and interface USART, SPI, I2C. On this signal input of the microcontroller signal processed on the channel ADC, data processing on the channel ADC is using 10-bit resolution [4]. The result of the processing of the analog data into digital data transmitted on a media viewer.

In the system also used Arduino Nano. The Arduino Nano is one product variant of the microcontroller output board Arduino. The Arduino Nano is the smallest Arduino board, using the Atmega 328 microcontroller for the Arduino Nano v3.0. Arduino nano functions as a reading of RPM.

In the system design also have Transmitter and Receiver (*Radio Telemetry*). The transmitter is a tool that serves to process and modulate the input signal to be transmitted in accordance with the wish of the Canal, while the receiver is a device that serves to receive and manipulate or output signal of the transmitter demodulation [5], so that it corresponds to the initial signal. Modules used on this form of delivery Radio Telemetry module which is a wireless data transmission, results of the transciever it will be linked on a media viewer data in the form of a personal computer or notebook.

In the system also used Hall effect sensor. Hall effects sensors can respond to the intensity of the magnetic field there are nearby [6-7]. This sensor has 3 pins. If there are no magnets around the (near) the sensor, then the output voltage is the same as setting the voltage supply. The function of the sensor measuring speed or RPM as the Motor of BLDC. As separated part in the system is Personal computers. In this research personal computer used as a media viewer interface voltage and current measurement data digitally, using VB software.

In Figure 2. show diagram of control monitoring and control of the speed. The first step is initialization input output. After this step, system can select on driver mode and control mode. In the driver mode, the driver can play potensiometer to run electric vehicle. If in the control mode, the speed can remote control to be able to maintain the

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rpm input that you wish to use when already incorporate the rpm sensor will read the rpm readout in send to visual basic. If the rpm read in accordance with the initial input of the motor goes according to rpm. If the read input from smaller rpm, pwm automaticly will add to adjust the rpm, but if in read more of rpm input, the duty cicle will decrease in accordance to the rpm input.

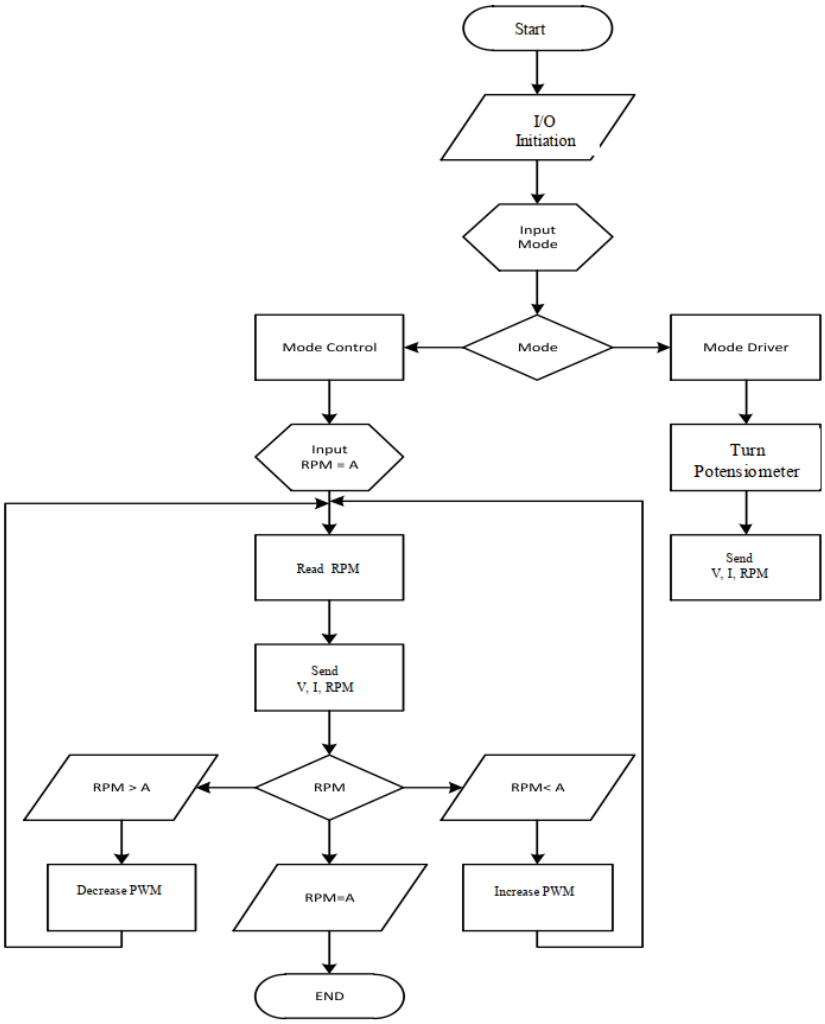

Fig. 2 Control Diagram

III.METHOD

In figure. 3 show figure of a flowchart of research.Steps in this research are as follows:

The first step of this research are looking for the literature of the previous research results, books or the internet to find out the characteristics of the components, work principles and theories that support the other. Expected with the literature can provide referrals to reduce errors in this research.

The second step is designing the construction of the tool will do the research. Expected from this construction design of the tool will be in thorough can be formed. It can done such as soldering and designing the monitoring system. After the hardware and software that has been tested. Testing is performed on each block and then the whole system.

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After testing the whole system works well and the result meets the target, then do next is the necessary data retrieval and then analysis data that has been obtained. At this end stage, the results of data retrieval and analysis are incorporated into the discussion, and then drawn some conclusions regarding the performance of the tool created and give advice that is meant to correct the deficiencies that exist, the possibility of development, as well as the refinement of the tools in the future.

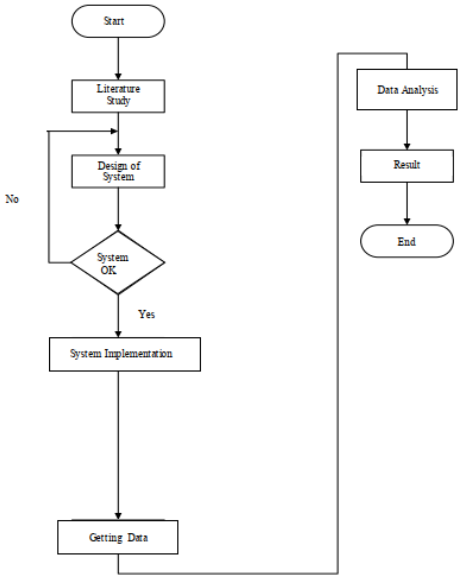

Fig. 3 Flowchart of research.

IV.RESULT AND DISCUSSION

4.1 Sensor Testing

Table 1 is a current sensor testing. The value of the ADC (Analog to Digital Converter) is the value of the analog output sensors that read and converted to digital by the Arduino. The range of values of 10-bit Arduino ADC itself is 0-1023. This value is then converted to value by quantity and unit of raw, in which case the unit is ampere, then tested several times with different current testing every done and compared to the measuring instrument, so that the obtained value of the difference between the value of sensor error of measuring instrument.

The largest error values are on third of data retrieval, but the value error 2.2222 overall average of only 1.4432%. From the calibration data of the current sensor can do the measurement with precision because has an average value of error percent low.

Table 2 is the voltage sensor testing. Data that the value of the percent error of 0.15 so in this test, the voltage sensors can tell the value of a high accuracy because it has a small percent error value.

Data on the table 3 show speed sensors, then going tested compared to measuring instrument with several times the motor speed testing with fruit. The value of the biggest mistake while on a second retrieval data valid of 3.09%. Figure 4 is the figure display to get the look of the software as in the picture above the first thing to do is to design the appearance of the software Visual Studio 2012.

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Table 1 Current Sensor Testing

data retrieval	Current sensor		instrument measuring (Ampere)	Error (%)
	ADC	Sensor (Ampere)		
1	515	0,19	0,18	5,5
2	530	0,88	0,89	1,1236
3	539	1,32	1,35	2,2222
4	543	1,62	1,61	0,6211
5	557	2,26	2,27	0,4405
6	570	2,85	2,95	3,3898
7	586	3,63	3,63	0
8	598	4,36	4,40	0,9842
9	614	5,03	5,08	0,9842
10	631	5,87	5,93	1,0118
11	655	7,02	7,05	0,425
12	671	7,81	7,86	0,636

Table 2 Voltage sensor testing

No.	Voltage sensor	Instrument Measuring	Error (%)
1	46.8	46.87	0.15
2	47.22	47.27	0.11
3	48.34	48.36	0.04
4	49.04	49.08	0.08
5	50.83	50.88	0.10
6	51.56	51.59	0.06
7	52.41	52.48	0.13
8	53.15	53.18	0.06
9	54.14	54.17	0.06

Table 3 Speed Sensor Testing

ADC	Tachometer (RPM)	Speed Sensor (RPM)	Error (%)
186	88	90,401	2,73
276	133	137,104	3,09
398	181	180,372	0,35
447	215	217,928	1,36
463	229	227,02	0,86
530	260	258,34	0,64
563	284	279,476	1,59
645	312	318,604	2,12
681	340	335,74	1,25

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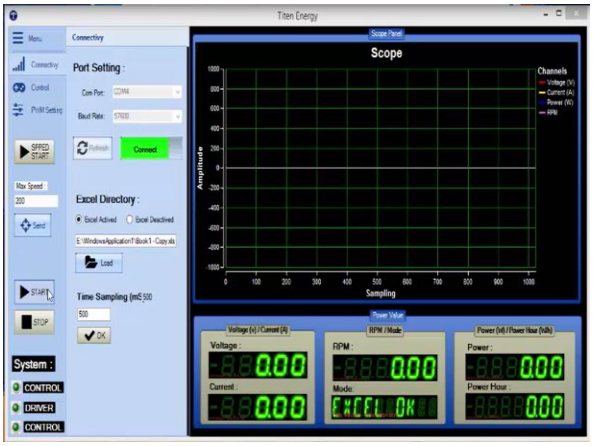

Fig. 4 Display monitoring

Table 4. Testing radio frequency

NO	System		Loss %
	Rx	Tx	
1	0.54	0.53	1.88
2	0.48	0.48	0
3	0.51	0.53	3.77
4	0.57	0.56	1.78
5	0.50	0.53	5.66
6	0.48	0.48	0
7	0.60	0.61	1.63
8	0.54	0.57	5.26
9	0.47	0.46	2.17
	Average %		2.46

Table 4 shown the results of testing Radio Frequency Telemetry Radio module 915MHz with a distance of 300 meters. In the get data packet loss data most of 5.66%, with average packet loss of 2.46%

4.2 Dynamic Testing

The dynamic testing done in the area of the University of Jember. In this testing, two of the first test with the enable mode on the monitoring and control with the mode control and second mode drivers. Testing is done using Urban EV2 TITEN car belonging to a team of University of Jember Titen electric car. Data speed, current, voltage, power, power consumption, as well as the time recorded by using the data logger.

Fig. 5 and fig. 6 shows the graph of the current relationship with time, and graph the relationship with speed. It can be seen that the current effect on road conditions and load the car when the car want to initial conditions drove the flow up to 6.76 A this owing to the car at the time of the initial conditions need a large torque so that the high currents flow may change. Up and down because depending the value of pwm changing change to arrive at the value of the reference speed in want. average current in this test of 2.650.

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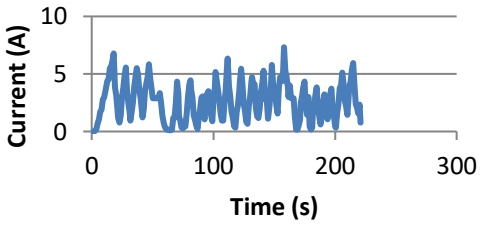

Fig. 5 The value of current road conditions straight

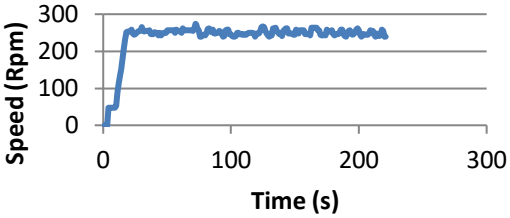

Fig. 6 The value of the straight speed

Fig. 7 and fig. 8 shows a graph of the current relationship with time and the speed against time. It can be seen that the current effect on road conditions and load the car can be seen when the car down the current 0.01 because motor without load.

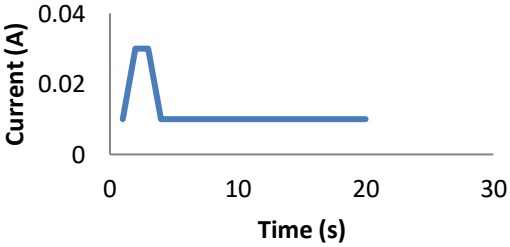

Fig. 7 The value of the current condition of the road down

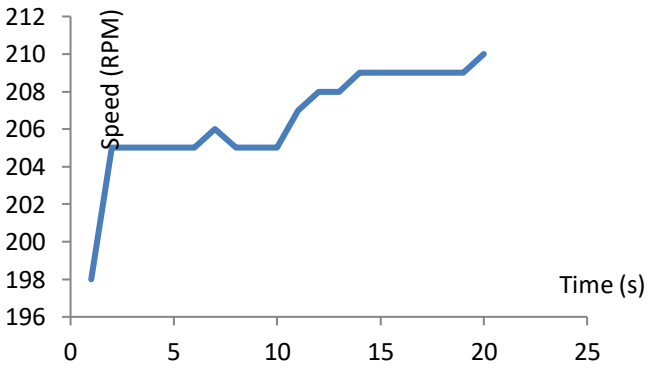

Fig. 8 The value of speed way down

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Fig. 9 shows the graph of the Current relationship with the time on the road conditions turn. In this condition the current increase when turn the highest current of 6.35 average value with a current of 4.572083 a. this happens because there are tire friction and thrust the car ride.

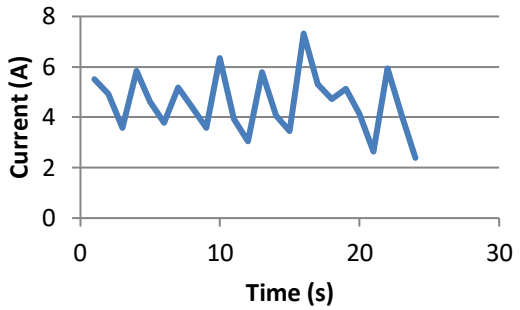

Fig. 9 The value of current road conditions turn

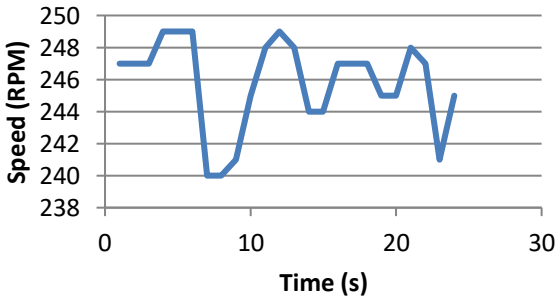

Fig. 10 The value of speed way turn

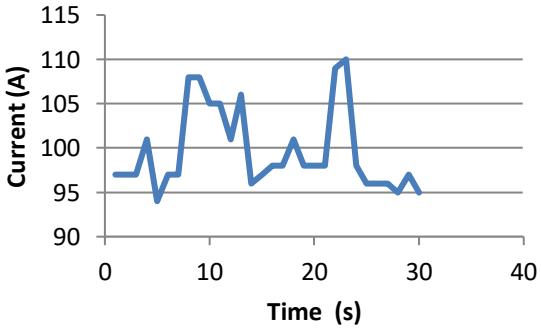

Fig. 11 The value of the current condition of the road climbs

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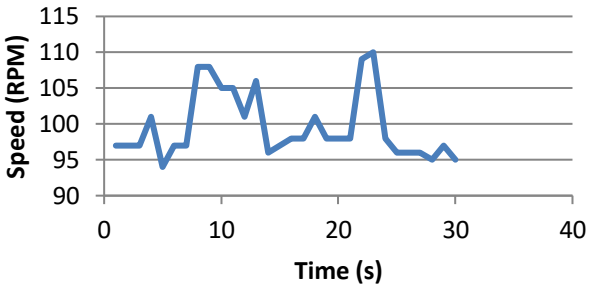

Fig 12 The value of the speed of the road climbs

On the conditions above can in see Fig.11 and Fig. 12 relationship charts current with the times on the condition of the road climbs and climbs a road speed graph with the maximum current value of 7.93 A and the average value of a current of 7.451 A.

In Fig. 13 shows the display of monitoring and controlling the speed regulator driver mode directly from the electric car drivers. Can display the voltage, current, power, Wh, and RPM. In Fig.14 shows the graph of the current relationship with time can be best demonstrated that the current effect on road conditions and load the car when the car want to initial conditions drove the current slowly increased until the highest current in the research mode driver this with a current average 4.857525 12.77

Fig. 13 Mode display driver

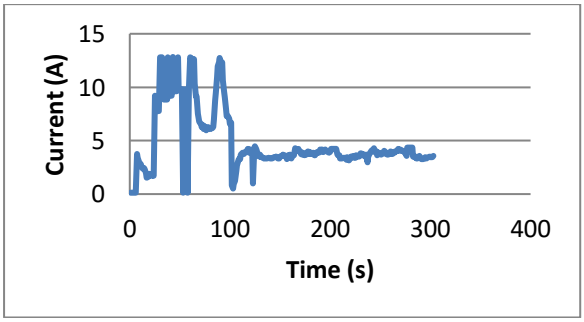

Fig. 14 Current mode driver

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Website: www.ijareeie.com

Vol. 8, Issue 9, September 2019

V. CONCLUSION

Based on the research result, it can be drawn some conclusions:

1. The design of monitoring and controlling system on testing this system in the get system goes well with speed control mode control and mode drivers on some road conditions.
2. The system of monitoring the current value of the control mode of the condition of the road climbs of 7.93 A this occurs because large car torque.

On mode control speed controller running well on road conditions straight reference value of speed 250 with testing in may average speed 238,3213, on road conditions turn at speeds of 250 in value can reference an average speed of 245,79, at a time when road conditions can be fall in the value of the speed of 206.55 climbs on the conditions when you reference speed value of 100 in the get the value of the speed of an average of 99,63.

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