Automation Testing System for Energy Efficiency of Electric Fan Based on SNI IEC 60789:2013

Q Lailiyah*, P Bakti, N Kusnandar, I Kasiyanto, H Tjahjono and I Muchlis

Research Center for Quality System and Testing Technology, Indonesian Institute of Science, Puspiptek Region Building 417, Setu, Tangerang Selatan, Banten, Indonesia

*quds001@lipi.go.id

Abstract. Automation system testing is needed by testing laboratory to reduce testing time. This paper attempt to examine the developed automation testing procedure to the effectivness testing duration. For this purpose, SNI IEC 60789:2013 was applied as testing procedure and the effectivness of testing duration was determined by comparing the duration test of developed automation procedure against manual procedure. The mechanical system component consists of a rail that can drive an anemometer buffer according to the desired distance. The process of moving an anemometer is electronically controlled by relay and timer. An anemometer sensor produces digital data to be read and recorded by the computer. The data of wind speed and electric power from the fan are calculated manually to obtain the percentage value of energy efficiency. This system can significantly reduce test time.

1. Introduction

Electric is the final form of energy that gives effectiveness and ease of use. In Indonesia, electric consumption at the end of 2015 increased by 2.13% from the previous year, and the largest consumption was in the household sector [1]. Many household appliances are switching to using electrical energy sources, one of which is a fan. Fan became one of the household appliances that are popular in the community considering Indonesia is a tropical country [2]. This condition will certainly increase the load of national electricity consumption if there is no effort to suppress the growth. Therefore an increase in fan efficiency energy is a strategic solution without suppressing the growth in demand for such household appliances.

Determination of minimum energy consumption level is very important to be done in an effort to increase energy efficiency of household appliance fan [3]. Currently the ESDM ministry is preparing a draft related to the Energy and Mineral Resource Regulations on Minimum Performance Standards (SKEM) and Inclusion of Energy Saving Label Labels for Fan. To support this, need for readiness in testing system for energy efficiency of electric fan. Therefore, it is necessary to conduct research and development in the field of measuring methods for fan energy consumption. In development of energy testing methods, test procedures must can be repeated and producing accurate data [4]. National standard that regulates the electrical fan performance measurement method that is SNI IEC 60879: 2013. Based on these methods the energy-saving rate is determined by the airflow generated by the fan compared to the electric power consumed [5].

Energy efficiency test method of electric fan requires realtime data monitoring and distance position settings with many shifts in measuring point. This has an impact on the length of test time and the high involvement of operators on each measurement. Both of these problems have the potential to decrease the accuracy of the test results. The solution to this problem is create of a test system that can work automatically. Automation test system can speed up the completion of testing and improve the accuracy and precision of the test results.

2. Test Setup According SNI IEC 60789:2013

Testing method of energy efficiency for electric fan is based on SNI IEC 60879: 2013. The electric fan used in this research is a stand fan. The positioning of the fan is set in the standard. The center of the fan blade is placed 1.5m from the floor and the front of the blade is at least 1.2m from the rear wall, 1.8m from the side wall and 4m from the front wall [5].

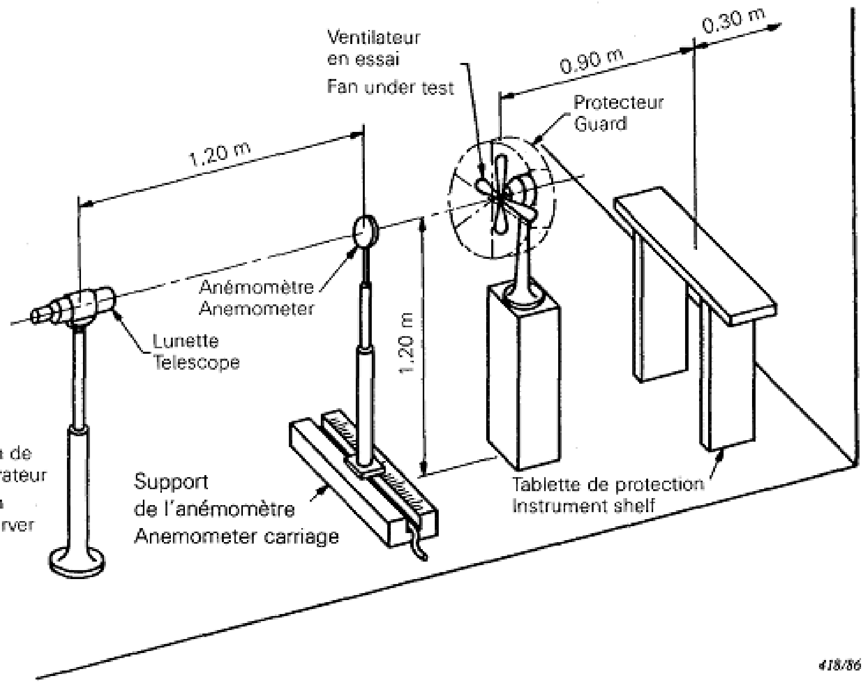

Figure 1. Test setup based on IEC 60879:1986 [6].

Before performing the test, the fan has operated and steady at the test voltage. Measurements are made on the fan operating at full speed. The air velocity reading starts at a point 2 cm from the axis of the fan blade, and should move forward along the horizontal line, with an increase of 4 cm wide and observed for 120 seconds each increase of 4 cm wide. Data retrieval is carried out until air speed falls below 24m / min.

3. Initial System

Several laboratories in Indonesia are receiving equipment assistance from the BRESL-UNDP program for energy efficiency testing of several household products [7]. For testing of efficiency energy for electric fan, there is a mechatronic system for moving an anemometer as shown in the figure 2. The mechanical system consists of anemometer supporting pole, DC rail and motor. There is an electronic control system consisting of a mechanical stopper, a dc voltage source and an anemometer direction button.

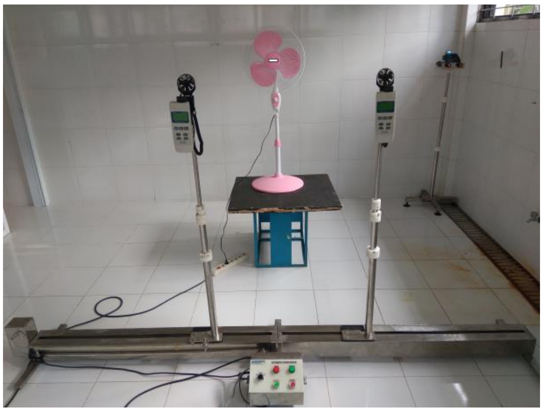

Figure 2. Mechatronic system of anemometer sensor driver.

The operation of the system to get a distance of 4 cm is still through direct observation that is by looking at the ruler that is available on the system. If the movement has reached 4 cm, the system is switched off manually by disconnecting the source voltage contact via switch on / off. To move it back is also done by turning the switch on / off and pressing the green or red direction button. This process is quite time-consuming and effort, especially when the test volume is overwhelming.

4. Automation System Design

Automation system that will be made is a system based on the rules of on - off control. According to Ryniecki, "the on-off control is the most common type of control used in industry because discontinuous actuators, like relays or solenoid valves, are simpler and cheaper than actuators used in the continuous type control systems"[8]. Therefore, in this study the authors want to try to make the design of automation systems using relays and timers that will be incorporated into existing systems.
The timer used is a H3CR-A8 timer that has 8 pins. There are 5 types of operation mode that isA (ON-delay), B (Flicker OFF start), B2 (Flicker ON start), E (Interval) dan J (One-shot). The time limit output type is relay output (DPDT)[9].

The MK2P-I relay has 8 pins with a working voltage of 250 VAC. The maximum current is 10 A at resistive load and 7 A for inductive load with power factor 0.4. Operation time while in AC voltage is 20 ms and release time at 20 ms maximum [10].

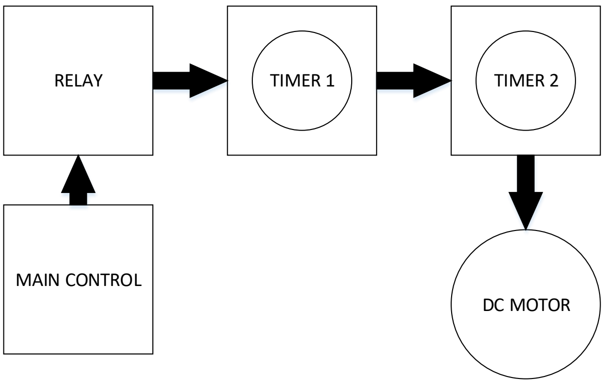

Figure 3.Block diagram design automation system.

Based on the figure. 3, the existing system will be integrated with 2 timers and relays. The main control consists of a switch on / off and directional keys, the red button to move away from the midpoint, and the green button is the opposite. Timer 1 is a timer that will be used to delay during a certain time so that the anemometer can record the airflow from the fan. Timer 2 delays for a certain time, assuming the anemometer support pole can move as far as 4 cm during the timer 2 works.

System workflow based on the Figure. 3 is the main control system provides a signal to the relay where the received signal is a voltage that will determine the direction of motion of the system. The signal from the relay will go to timer 1 and activate the timing, along with it timer 2 will also work and start the timing calculation. When timer 2 does the calculation, the dc motor will move and will stop when timer 2 finishes the calculation. Timer 2 will be active again after timer 1 finishes the calculation.

Figure 4. Automation system design with relays and timers.

5. Results and Discussion

Adjustment is performed to obtain an accurate value for both anemometer readings and anemometer pole movement. The result of the adjustment is quite close to the standard requirement which the timer setting for 2 minutes, resulting in a measurement delay of approximately 2 minutes. Setting timer 2 for 4 seconds, resulting in a movement approaching 4 cm. The results more clearly can be seen in table 1.

Table1. Measurement of points shift and times of data collection.

Data Collection	points shift (cm)		difference between points shift (cm)		Time of data collection between points (s)	
	automatic	manual	automatic	manual	automatic	manual
1	4	4,15	-	-	-	-
2	8	8,1	4	3,95	124	151
3	12	12,05	4	3,95	124	155
4	16	16,2	4	4,15	124	150
5	20,2	20	4,2	3,8	124	145
6	24,4	24,3	4,2	4,3	124	144
7	28,7	28	4,3	3,7	124	143

Based on table 1 it is seen that for shifting point of measurement in automated system has value of difference approaching standard requirement while the biggest difference value exists on taking data to 7 with value 4,3 cm, more 0,3cm than specified standard. As for the manual system obtained the same value, there is a difference of 0,3cm from the desired standard on the collection data to 6 and to 7 that is equal to 4,3cm and 3,7cm. Viewed as a whole, the difference between point shifts in automated systems is more precise than the manual system.

The difference in movement occurring in the automation system is due to the different friction between the anemometer with the rails at each point. For manual systems there are also differences between points because the reading of the measuring instrument is not ideal because the position of the ruler is at the bottom of the rail.The data retrieval time for the automatic system is quite precise due to the settings on the 1st and 2nd timers that are consistent. The average data retrieval time for the automatic system is 124 seconds. For manual measurement the average data retrieval time is 148 seconds. There is a 24 second difference where data retrieval is automatically faster.

6. Conclucion

Automated systems that have been designed are close to the standard desired specifications. This system is able to reduce the data retrieval time of 16.22% from manual system. The precision in shifting between points, both automatic and manual systems is still lacking, so the need to develop control methods to improve its precision.

Acknowledgement

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