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CHARACTERISTICS OF LIMITING DEVICES OF ELECTRIC POWER USE TRIAC BASED MICROCONTROLLER

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ABSTRACT

In fact in the household, electrical power coming from a network of PLN (The state electricity company) is limited by MCB (Miniature Circuit Breaker) which is a current limiting devices made of bimetallic that works based on the current through the bimetal. When the electric current exceeds the nominal current MCB, the MCB will trip. While the measurement of electrical energy is still wearing KWH Meter analog / disc. But along with the times and technology it was developed KWH digital meter that also serves as an automatic current limiting in general KWH meter installed in each home where every house electric subscribe to PLN. The problem is if the subscription is the occupants of a dorm room with the electrical load is relatively small (only in one room only) so that when mounted KWH Meter (contractual power) per room then it will be too big electricity subscription fees. As the evaluation to limit electrical power per room then used Delimiter Tools Electricity With Triac-Based Microcontroller that serves to limit the supply of electrical power to each room in accordance setting the maximum power fed through the keypad. The final result shows if the presence of a load on one or several rooms not exceed 350 VA setting point, the flow of electrical current still flows (Triac ON). Whereas if the presence of a load on one or several rooms exceeds the setting point of 350 VA, then the flow of electric current disconnected (OFF Triac).

Keywords: limiting devices, electric power, triac, microcontroller.

INTRODUCTION

Background

The need for electricity from year to year increases; it requires people to be wise and prudent so that it can achieve efficiencies in the utilization of electrical energy. In fact the scale household electric current coming from network PLN limited by MCB (Miniature Circuit Breaker) which is a current limiting devices, which work by heat. At MCB there will bimetal curved plate in case of overheating due to an electric current through it exceeds the nominal value. Bimetal plate is curved because the heat will move a lever breaker and will cut off electric current. The problem is if the subscription is the occupants of a dorm room with the electrical load is relatively small (only one room), so that when mounted KWH Meter (contractual power) PLN per room then it will be too big a subscription fee of electricity.

According to the study conducted by Satria Bagus CF. (2014) electric power can be controlled with an application automatic control system based microcontroller Atmega 16. In controlling the system uses on-off control action. As the actuator is used a relay along with drivers while the sensor, using sensors flow -based effects ACS712 Hall. The system is equipped with a keypad to enter the set point of the power and LCD viewer to monitor the measured current.

Research on electric power restrictions have been done by previous researchers among others by Leonard Kovalsky *et al* (2005), Steurer *et al* (2004), Iwao *et al* (2006) and Gökhan *et.al* (2013). However, research on the limiting devices of electric power by using a microcontroller Atmega8535 and TRIAC at a boarding house had never been done before.

In our study to limit the power in each room boarding house we built a tool for limiting electric power, which is based Microcontroller Atmega 8535. As a means of connecting and disconnect the load we wear Triac, which functioned as a switch, as an insulator on his driver circuit we use MOC3041 optocoupler. To monitor the load current we use 712 ACS current sensors power setting value for each room is entered via the keypad. While the value of the power settings load current and power is supplied and displayed on the LCD. The final results showed these tools can work well to limit the electrical power to each room according to the value set point of the maximum power that is inserted into a device limiting electrical power.

Formulation of the problem

Based on the background, it can be formulated the problem how the performance of the electric power divider using Triac-based microcontroller in limiting the power consumption at the customer's home type boarding houses.

Research purposes

To make a device limiting electric power using Triac-based microcontroller that can limit the power consumption of each room of boarding house.

LITERATURE REVIEW

Delimiter of an electrical power

According Aprianti *et al* (2010) a solution commonly used to limit public power flowing in an electrical appliance including the light is to use the mini circuit breaker (MCB). With MCB, then the current flows will be disconnected if beyond the current, which is allowed by the MCB. The downside of this conventional method is the value of the power can not be set according to the needs. So will have difficulty if power applications (current) which varies according to the load.

Slamet Hani (2009) states that the development of technology and electronic systems today have grown very rapidly. Not in spite of this the use of power tools increased along with the need for users to have a work activity. Therefore, we need a tool that can protect electronic equipment from fire hazards as a result of excessive electrical energy consumption resulting in a short circuit that may occur fire.

Automatic control system that is applied to limit the electrical power has been designed and developed based on ATMEGA16 microcontroller. In controlling the system uses on-off control action. As the relay actuator is used along with drivers while the sensor using Hall effect based current sensor ACS712. The system is equipped with a keypad for entering set point power and LCD viewer to monitor the measured current (Riny *et al*, 2012).

TRIAC

Triac is a semiconductor component that acts as a high-speed power connector. In general, the triac is operated at a voltage of over 100 V and can carry current more than 100A. So triac is often used in AC power control systems such as light dimmers (dimmer), heating control, motor speed controls and more. Triac and SCR is a family of thyristor which has the same working principle. What distinguishes the two is the efficiency of usage. SCR is a half- wave controller or control one direction. This may imply that the SCR is only able to control the AC voltage on the positive period while the negative period is not controlled. Even in some applications, the SCR is used as the main controller both controllers phase 900 and 1800. As for the triac, a bidirectional control or full wave. This is very effective for AC load control purposes (Sri Hardiati *et al*, 2009).

According Rini Nur Hasanah (2012) TRIAC chosen as power converters used in energy-saving algorithm implementation. The method used in the form of reduction of the input voltage applied to the motor when the motor is working with a load less than nominal load. The use of TRIAC allows this can be done because when the trigger of his work can be adjusted by adjusting the firing angle, which in turn will affect the value of the effective voltage applied to the motor.

TRIAC (triode for alternating current) is an electronic component that is almost the same as two SCR connected antiparallel and foot gate connected. Triac is used to control the light. These controlled lights can be set brightness level. Triac is a major component of the circuit dimmer (Rizki Pria Pratama, 2013).

ATmega 8535 microcontroller

According Eka Mandayatma (2009), mikrokontoller is an IC chip where there microprocessor and program memory (ROM) as well as a versatile memory (RAM) and even some types of microcontroller which has the facility of ADC, PLL, EEPROM in one package. The use of the microcontroller in the control field is very broad and popular. AVR microcontroller (Alf and Vegard 's Risc processor) has architectures RISC 8 bit, where all instruction packed in code 16 - bit (16 - bits word) and most of the instruction executed in one clock cycle in contrast with the MCS - 51 which requires 12 cycles clock.

The minimum circuit microcontroller system is an essential part of the system are made the most important component is the microcontroller IC ATMega8535 serves as a kind of brain that runs the instructions stored in the calculation of current, voltage and power as well as for controlling the some devices. Microcontroller is a chip inside the computer that is used to control electronic devices. To be able to do useful things with using microcontroller then takes a combination of hardware and software that is suited. So the hardware and software for applications using a microcontroller embedeed system are inextricably linked and both aspects of the design of the complete system needs to be considered together (Andi Setiono and Suharto, 2009).

RESEARCH METHODOLOGY

Time and location of research

The research was conducted starting in December 1, 2013 until May 15, 2014 with the location of the research in the Laboratory of Power Electronics, Electrical Engineering, Institut Teknologi Adhi Tama Surabaya-Indonesia.

Flow chart of research

Flow chart of the study is the overall diagram of the entire interconnected system. Where it will support the performance of the tools to be designed. Here is a picture flowchart of research to be conducted:
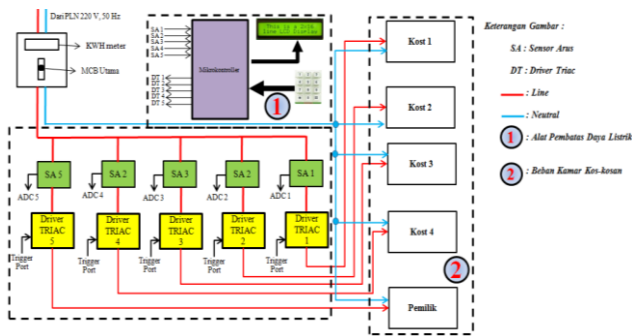
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Figure-1. Flow chart of research.

Figure-2. The actual circuit loading for room boarding house.

From Figure-1 it appears that the system consists of two blocks namely:

a) The limiting of the power tool, this tool consists of five parts: (a) the current sensor, this sensor serves as the reader value of the current flowing to each load (SA 1 - SA 5), (b) Triac Driver is serves as an actuator for connecting and disconnecting the load according to the instructions of the microcontroller, (c) microcontroller ATMega8535 is functioning as controller of all the working parts of the system, (d) keypad is used to input the value of the maximum power in each room, (e) LCD is a function displays the value in the input power, the current flowing to the load and the value of the real time readings on the power supply to the load .

b) Load. This section consists of four dorm room and one part to the owner of the boarding. These sections which is in control of its use. In this study, there are several types of commonly used load on the scale of a boarding house, lodging house among others: Incandescent 25 watt / 220 volt, phillip brand CFL bulbs 14 watt / 220 volt, fan cosmos brand type 7KV 20 watt /

220 volt. Iron, brands Phillip type H1 114 350 watt / 220 volt as shown in Figure-2.

Designing and making software

The minimum system firmware ATmega 8535 is the firmware that will be compiled into the microcontroller, so that the microcontroller can operate in accordance with what we want. Making of this firmware is to use software support CodeVision AVR. Before starting the programming, the first to do is create a flow chart that explains an outline of the work program. Here is a flow chart of a program which will be applied to the microcontroller.
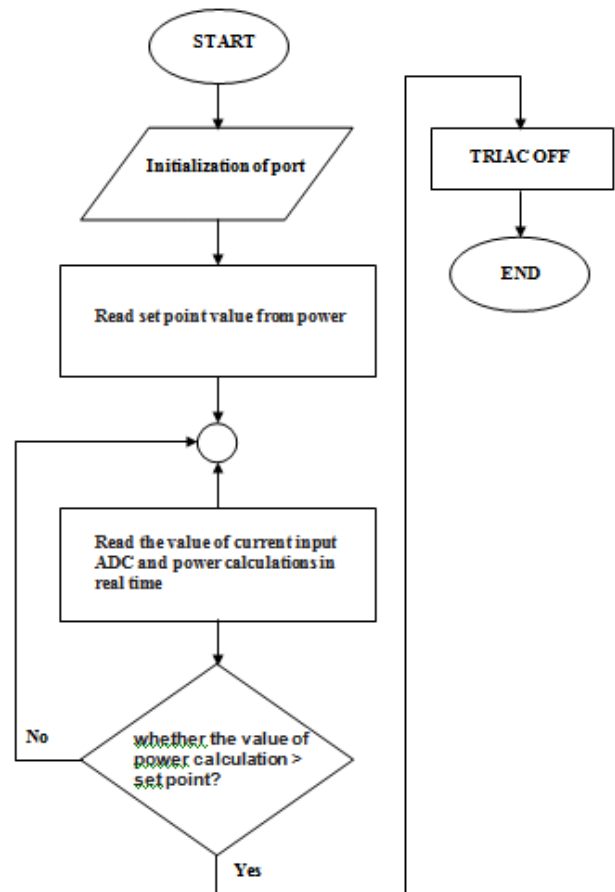

Figure-3. Flow chart of programming the microcontroller.

From the flow chart above can be described as follows:

a) Perform initialization sensors, input and output as early declaration to the value and number of variables form the sensor.

b) Read the value of the set point in the electrical power input through the keypad.

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c) Reading the ADC value in the form of electrical quantities converted by calculation according to the characteristics of current sensors are used.

d) Compare the value of power real time from the processing of current values read by the sensor voltage multiplied by the value of the set point.

e) Giving instructions to Triac, to be on or Off according to the conditions the comparison between real-time power to the set point.

Formula reference for power supply analysis

Power value is the value that is supplied to each room can be calculated using a formula to find the apparent power namely:

$$S = V . I \tag{1}$$

Dengan: S = Real power (VA)
          V= Source voltage (Volt)
          I = Load of current (Ampere)

Data analysis

To view the performance of electric power limiting devices using a triac -based microcontroller in limiting the power of in-room boarding house it is necessary to test. Tests using a comparative method which compares the dorm room that does not use electric power limiting devices with a dorm room divider that uses electric power tools.

RESULTS AND DISCUSSIONS

Data from measurement results in each room without using limiting devices of electric power

a) Load of incandescent bulbs 25 watt and fan 20 Watt.

Table-1. Measurement results without limiting devices of electric power with a load of incandescent and fans.

Area	Voltage (V)	Current load (A)	The power is supplied to load (VA)
Room 1	221	0,19A	41,99
Room 2	221	0,19A	41,99
Room 3	221	0,19A	41,99
Room 4	221	0,19A	41,99
Owner	221	0,19A	41,99

b) Iron load of 350 Watts and incandescent bulbs 25 Watt.

Table-2. Measurement results without limiting devices of electric power with iron load and incandescent lamps.

Area	Voltage (V)	Current load (A)	The power is supplied to load (VA)
Room 1	221	1,74	384,54
Room 2	221	1,75	386,75
Room 3	221	1,74	384,54
Room 4	221	1,74	384,54
Owner	221	1,74	384,54

Data from measurement results in each room using limiting devices of electric power with setting point maximum power 350 VA

a) Load of incandescent bulbs 25 Watt and fan 20 Watt

Table-3. Results of measurement using a limiting device of electric power with incandescent lamp and fan with a value of set point for maximum power 350 VA for each room.

Area	Voltage (V)	Current load (A)	The power is supplied to load (VA)
Room 1	221	0,19A	41,99
Room 2	221	0,19A	41,99
Room 3	221	0,19A	41,99
Room 4	221	0,19A	41,99
Owner	221	0,19A	41,99

b) Maximum load (Iron and incandescent lamps).

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Table-4. Measurement results using limiting devices of electric power with a value
of set point for maximum power of 350 VA to each room.

Area	Voltage (V)	Current load (A)	Power is supplied to the load when the condition of Triac is OFF (VA)
Room 1	221	0	0
Room 2	221	0	0
Room 3	221	0	0
Room 4	221	0	0
Owner	221	0	0

DISCUSSIONS

In accordance with the above conditions, it can be observed that:

a) From Table 1 and 2 with no installation of equipment of power limiter on each load boarding house room, then whatever existing load of five rooms for a total power (total power of the rooms 1-4 and owner) has not been exceeded of installed power from PLN (main MCB), then the current flowing to the load, so the power supply in each of the rooms is not controlled.

b) At the time tried in a room loaded electric irons 350 watt and 25 watt incandescent bulb, it turns out the number of the existing load of 375 Watts which means exceeding the power setting of 350 VA, the power limiting devices work and cut off electrical current to the room which intended as shown in Table 3 and 4.

Of the two things mentioned above, it can be stated that:

a) If the presence of a load on one or several rooms do not exceed the setting point 350 VA then the flow of electrical current still flows.

b) However, if the presence of a load on one or several rooms exceeded the setting point 350 VA then the flow of electric current is disconnected.

CONCLUSIONS

Based on the measurement results and discussion it can be concluded that:

If the presence of a load on one or several rooms is not exceeded the setting point of 350 VA and then the flow of electrical current still flows (Triac ON). Whereas if the presence of a load on one or several rooms exceeded the setting point of 350 VA after that the flow of electrical current is disconnected (OFF Triac).

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