

Detection and Control System of Electricity Consumption Towards Smart Vocational Education (SVE)

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ABSTRACT

This research is a follow-up research to improve performance of Smart Control Electrical Energy (SiSCE) at idle time. In previous research, device serves to control consumption of electrical energy outside from operational hours of the institution. In this study, device performance is improved to be able to detect activities in one room and control consumption of electrical energy during institutional operating hours. The device is a combination of PIR, WSN, IoT sensor technology and monitoring based on mobile. Work process is to detect activities in one room, if there is no activity, current of electrical energy to device will be stopped. If there is activity, current of electrical energy will be turned back to device. The device is named Smart Detection and Control Electrical Energy (SiSDeCE). Location testing is carried out in campus of Politeknik Negeri Medan. The result was saving energy percentage 50.2%

Keywords: *Idle Time, Smart Control Detection, IoT, PIR, WSN.*

1. INTRODUCTION

This research is continuation of previous research on smart control electrical energy (SiSCE) at idle time. The results are using of SiSCE can save electrical energy by 46.8% [9]. Another research by PT. Energy Management Indonesia (EMI) shows the percentage of electrical energy wasted at idle time, namely 25-30% at government offices, 20% at private offices, 25% at industry, 10% at households, 25% at shop and market [1],[13].

Saving of electrical energy can be increased actually by controlling process not only at idle time, but also during working hours and operational hours. For example, during break from meeting, certain room has no activity, but electronic equipment such as lamp, air conditioner, computer, printer and others often still on.

According to information above, Researchers propose to add features for SiSCE is not only at idle time but also during working hours to create Smart Vocational Education (SVE). The SiSCE feature is added with

motion sensor that can detect activity in workspace. If room has no activity, the system will automatically stop electrical current. If there is activity, the electrical current will be turned back. The device is named Smart Detection and Control Electrical Energy (SiSDeCE).

Data of electrical current at idle time and working hours will be collected and analyzed using dynamic system to predict saving energy consumption at certain period [8]. Result of research is expected to be a basic for redesign of electrical energy using at campus of Politeknik Negeri Medan.

2. METHOD

System functions as controlling and monitoring the electricity load. Monitored values are voltage (volt), current (ampere), power (watt), and electrical power used (kilo watt hours). Block diagram is presented as Figure 1. Furthermore, based on the block diagram scheme, it is implemented into block diagram control shown in Figure 2.

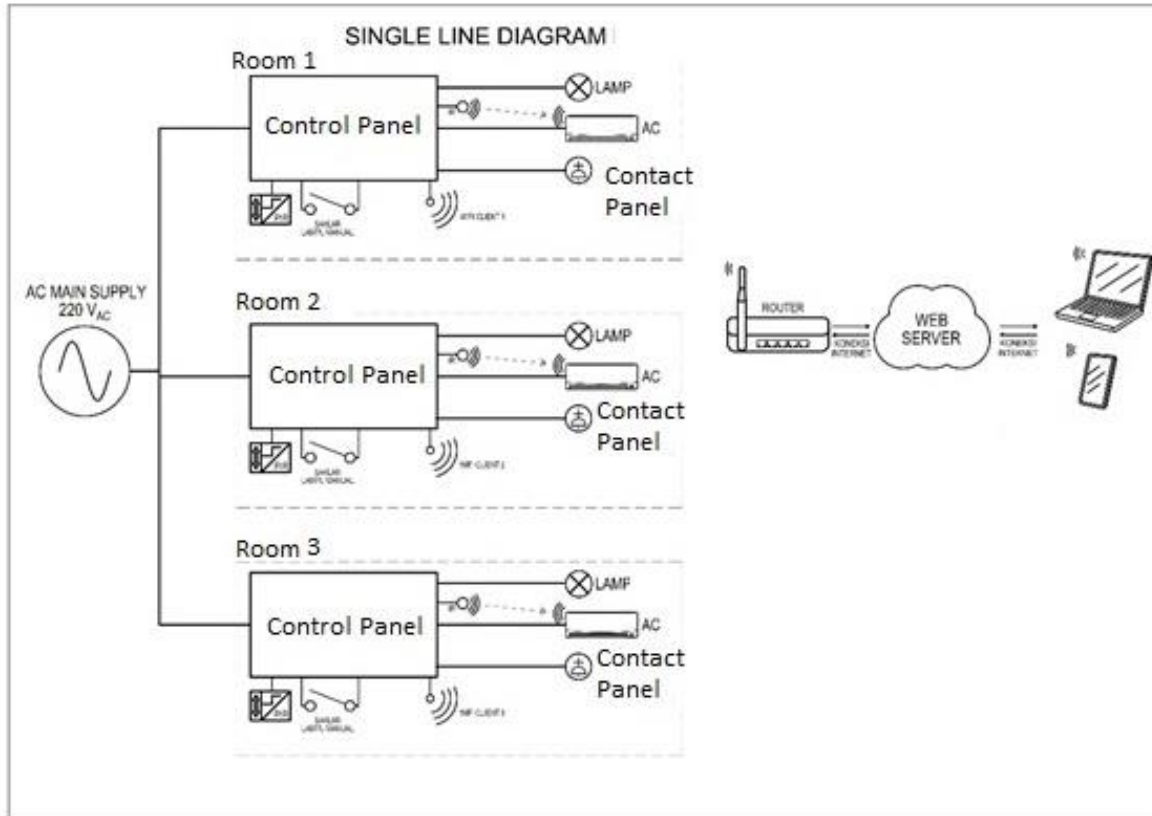


Figure 1 Block diagram

BLOCK DIAGRAM CONTROL

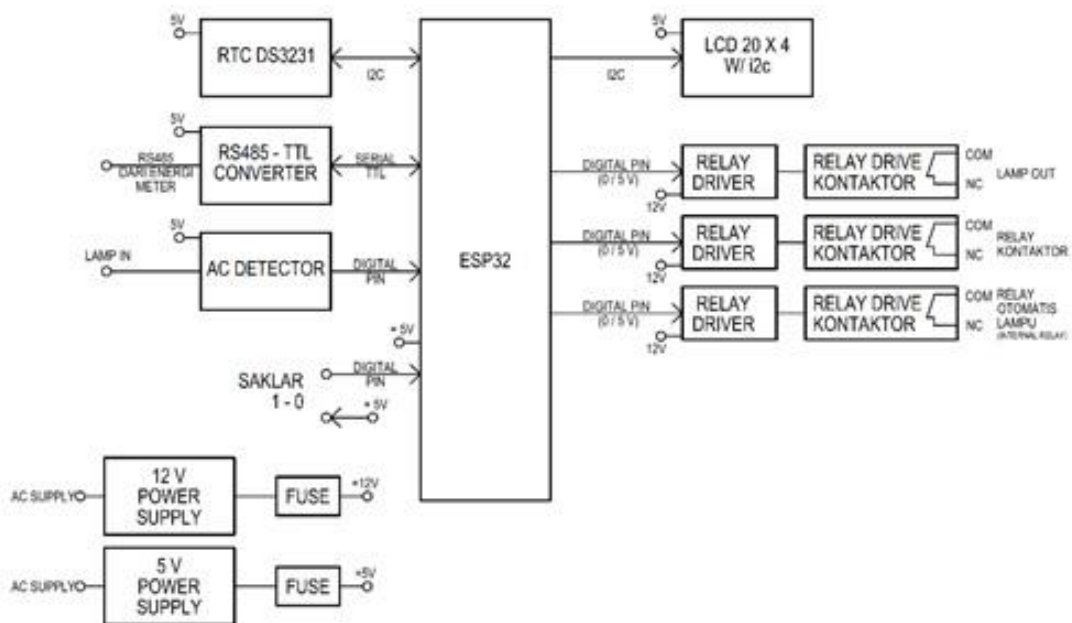


Figure 2 Block diagram control

Control panel function as monitoring and controlling electrical loads by automatically. Each room has one control panel and it works independently. Control panel communicates to web server using MQTT protocol. MQTT protocol can send data directly [2],[3],[5],[6],[7].

This research use microcontroller ESP32 as Internet of Things (IoT) module [4]. When the device is on, microcontroller ESP32 will initialize other electronic modules. Then the device will connect to wi-fi and read variable data from memory. System uses the time from the internet via the NTP server and via the RTC. Time data via RTC is used as a backup if the system is not connected to the internet. The system has 2 modes, namely manual and automatic. If in automatic mode, the system will divide into two sessions, namely operation and idle time. During automatic mode the system will always check whether current session has ended, if so, the system will enter the next session. If the next session is an idle time session, the system will cut the energy connection to the load. System will send electrical data and status to the web server for displayed. Any changes of the system will be stored in memory. When the system is restarted, it can immediately know what condition the system was before it turn off [10],[11],[12].

During automatic mode and during an operating session, system will be sampling the PIR sensor to find out whether there is anyone in the room or not. If the PIR sensor detects there is nobody in the room, the system will wait for 1 minute and if within 1 minute the room remains empty, the system will cut the energy connection to the load.

The device reads data from electricity from the Energy meter as long as 3 seconds. The electrical data will be read by the device are voltage (volt), current (ampere), power (watt), electrical power used (kilo watt hours). These parameters will be displayed on the LCD and will be uploaded to the web server.

3. RESULT AND DISCUSSION

3.1. Presenting the Results

Measured data results using SiSDeCE device is presented as shown in Table 1. Measured data results without using SiSDeCE device at idle time is presented as shown in Table 2.

Table 1. Measured data

Time	Voltage (Volt)	Current (Ampere)	Power (Kilo Watt)	Electrical Power Used (Watt Hour)	No Activities Time (Second)	Information
2020-10-21 07:00	235.00	0.38	0.08	0.00	0.00	Start Operational Session
2020-10-21 08:00	224.75	5.93	1.17	489.96	1795	
2020-10-21 09:00	225.56	6.34	1.26	1726.99	0.00	
2020-10-21 10:00	225.57	6.34	1.26	2944.03	0.00	
2020-10-21 11:00	224.75	5.93	1.17	3728.94	1009	
2020-10-21 12:00	225.18	6.15	1.22	4744.62	298	
2020-10-21 13:00	226.18	6.66	1.33	4966.19	2818	
2020-10-21 14:00	225.56	6.34	1.26	6120.05	178	
2020-10-21 15:00	225.16	6.14	1.22	7315.79	0.00	
2020-10-21 16:00	225.06	6.08	1.21	7929.00	1768	
2020-10-21 17:00	224.77	5.94	1.17	9064.19	119	Before Idle Time
2020-10-21 17:58	224.38	5.73	1.13	9665.72	1567	
Total	2711.91	67.94	13.47	58695.49	9552.00	

Table 2. Energy used at idle time

Time	Electrical Power Used (Watt Hour)	Information
2020-10-21 18:00	4120	Start Idle Time
2020-10-21 19:00	4180	
2020-10-21 20:00	4200	
2020-10-21 21:00	4140	
2020-10-21 22:00	4140	
2020-10-21 23:00	4200	
2020-10-21 24:00	4150	
2020-10-22 01:00	4130	
2020-10-22 02:00	4180	
2020-10-22 03:00	4170	
2020-10-22 04:00	4130	
2020-10-22 05:00	4130	
2020-10-22 06:00	4200	
2020-10-22 06:58	4140	Before Operational Session
Total	58,210	

3.2. Discussion

Data was measured using SiSDeCE device and without using SiSDeCE device. SiSDeCE mechanism was turn off electrical current at idle time and controlling based on human activities. Time period was 24 hours. According to measured data results in Table 1. Electrical power used was 58695.49 Watt Hours. If we didn't use SiSDeCE device. The result was 58695.49 Watt Hour + 58,210 Watt Hour and equal 116,905.49 Watt Hour.

This research is continuation of previous research on smart control electrical energy (SiSCE) at idle time. The results are using of SiSCE can save electrical energy by 46.8% [9]. After using SiSDeCE device to be saving energy percentage = $58695.49/116905.49 \times 100\% = 50.2\%$

4. CONCLUSION

SisDeCE was able to detect and control of electrical energy toward electronic equipment in room or building. SisDeCE was able to measure saving electrical energy during operation hours and idle time as well. Electrical energy saving in lecture buildings or offices by turn off electrical current at idle time and controlling based on human activities. For further research, it is necessary to develop SiSDeCE capacity to be able to control electrical consumption for one full building. It need on/off automatic switch according to activity in certain room and set the idle time via smartphone.

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