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DESIGNING OF ELECTRONIC BREAKER FOR HEAVY EQUIPMENT RENTAL COMPANY

Hidayat Hidayat[*1]
Abdul Muis[2]
Abdul Halik[3]
Darma Aviva[4]
*[1,2,3,4]Mechanical Engineering Department, Politeknik Negeri Samarinda, Indonesia

ABSTRACT
Heavy equipment rental is one of the most profitable businesses in Kalimantan as on f the biggest mining producers in Indonesia. Unfortunately, heavy equipment rental companies bear many losses when their units were used longer than the contract time deceptively. This research aimed to design and develop a device called Service Operation Breaker (SOB) installed in the Dozer D3K Caterpillar which controls the specified rental time based on RFID (Radio-Frequency Identification). The SOB is connected to the neutral start relay and the key start switch to manage the electricity connections and disconnections to the unit. The voltage and current were measured at different times to reveal the effect of using SOB at engine crank time and run time. Based on the literature, it can be said that the use of SOB is still safe when at the engine crank time and running time which was 21 volt and 27,6 Volt, respectively. The results show that the use of SOB to decrease time losses at a heavy equipment rental company was revealed.

Keyword: Service operation breaker, RFID, Kalimantan, Dozer D3K, Caterpillar.

INTRODUCTION

The development of technology and information in the digital era. Nowadays requires us to be able to do an innovation that can make it easier for humans to do their work so that it will increase their productivity and reduce the time. Moreover, the 4.0 industrial era which implements a computerized system will change the system from manual to automatic. The same thing also happened in the heavy equipment industry that experienced significant development, including in the area of East Borneo, which is the third-largest mining area in Indonesia, especially coal mining. The increasing number of small mines increases the need for heavy equipment. The need for heavy equipment rental services also rose in consequence because mining owners preferred renting than buying new units to minimize the cost and maintenance demand. The purpose of this research is to design and conduct an RFID (Radio Frequency Identification) basis Service Operation Breaker (SOB) using Arduino IDE software and ATmega2560 microcontroller on the Dozer D3K Caterpillar heavy equipment unit that can control the machine rental time.

The number of studies used RFID to develop a device for many purposes. RFID was used as a sensor fusion strategy for positioning is completely GPS denied environments [1]. Another study using RFID to solve the problem encountered in the parking-lot management system. A Central parking-car tracking system had been developed and utilized for automized income tracking system [2]. An RFID solution-based traceability to manage a large number of vehicles to use an efficient and robust control was developed. Measuring and testing were conducted to validate the proposed solution [3]. The use of RFID to perform circulation operation by reducing the amount of time required was provided. It also discusses the present status of RFID implementation for implementing in libraries [4]. Tracking and verification system using RFID and mobile technology developed for an SME in the UK to monitor assembly of parts for a manufacturing company [5]. Design and implementation of an accurate vehicle location system using RFID in combination with the GPS the GSM was performed by researchers [6]. To pass emergency vehicles smoothly by using an intelligent traffic control system was carried out [7]. However, as far as we searched, there is no paper using a tool such as Service Operation Breaker (SOB) based on RFID to control rental time in heavy equipment unit especially Dozer D3K Caterpillar.

The use of SOB is expected to minimize the differences of the actual unit operating hours to the operating hour's agreement so that the routine maintenance of the heavy equipment could be more well-ordered. Thus, the heavy equipment rental business's deficit can be reduced.

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METHODOLOGY

The data of the research was taken from one of the heavy equipment rental companies located in Jalan Tri Darma, Sungai Pinang District, Samarinda City and the manufacture of Service Operation Breaker (SOB) equipment was carried out at the Samarinda State Polytechnic Heavy Equipment Engineering Workshop.

The design of the equipment needs to be done more detailed by looking at the specifications of the unit to be used; as well as the components that will be used; so that the tool can be easily applied to the heavy equipment. Understanding the characteristics of each tool and material is also crucial; to avoid potential harmful work condition and danger that might occur, hence, work safety would be maintained. The main materials that were used in the design of the service operation breaker include Arduino Microcontroller, RFID reader, Relay Module, LCD and Buzzer.

The SOB in this study was applied to the Caterpillar D3K Dozer unit. Components are integrated into the electrical circuit units, particularly in the starting system. This SOB circuit will be able to connect and disconnect the current from the key start switch and neutral start relay. The component scheme of the Caterpillar D3K Dozer unit Starting system can be seen in Figure 1.

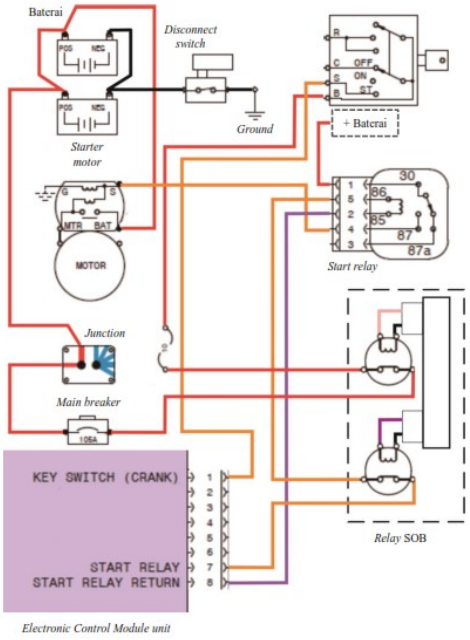

Figure 1. Starting System Scheme of the Caterpillar D3K Dozer unit

Two components were manipulated in the starting system electrical circuit of the Caterpillar D3K Dozer unit, namely the start relay and the key start fuse, which are shown above in Figure 1. For the device to be able to control the unit to turn on and activate the starting system, a scheme was needed in the electrical system of the unit. The scheme of the input components circuit, the process, and the output of the SOB can be seen in Figure 2 below.

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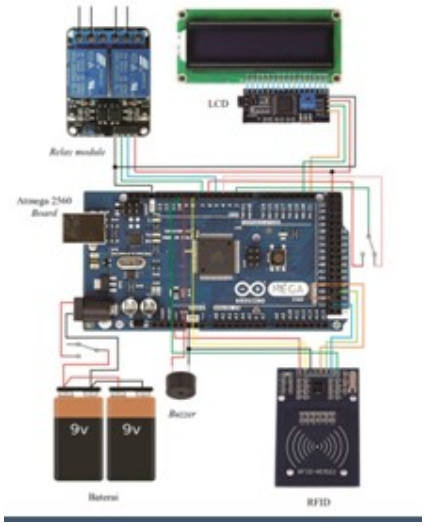

Figure 2. SOB Component circuit

RESULTS AND DISCUSSION

The SOB installation on the Caterpillar D3K Dozer unit is relatively easy because it uses certain extension cables on the start lock fuse and neutral start relay. The extension cable used was directly connected to the machine's electrical system. The integrated circuit scheme of the SOB and the Wheel Loader unit electricity unit will manage the electricity connection and disconnection to the key start switch and the neutral start relay. Consequently, the unit cannot operate because the electricity supply was cut off. Thus, the heavy equipment will stop. The integratied scheme of the SOB and the D3K Dozer unit electricity can be seen in Figure 3 below.

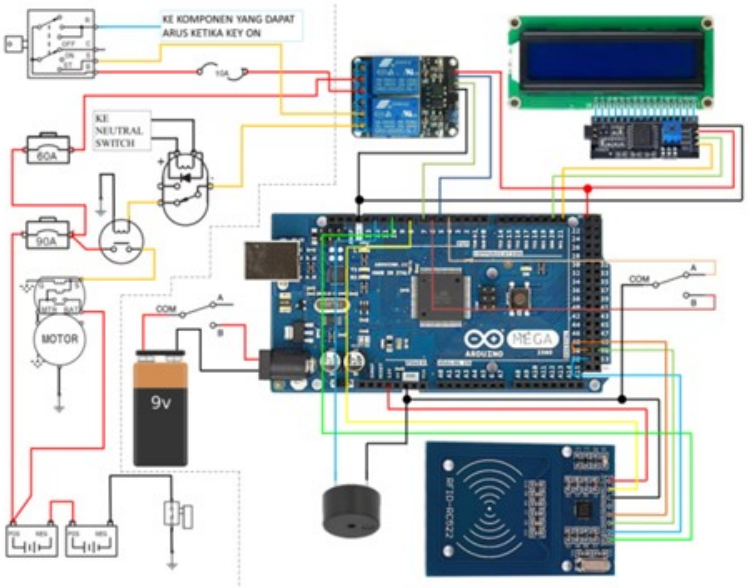

Figure 3. SOB circuit scheme on the Caterpillar D3K Dozer unit

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Heavy equipment that has been equipped with SOB will automatically be connected to the starting system circuit; so when the RFID component of the receiver cannot read the card, the engine cannot be started because the relay module for the start relay is active; cutting off the electricity supply to the starting system.

Card scanning could be done by holding the card closer to the RFID receiver. When the SOB successfully reads the card, it will start counting down the specified rental time. When the time is up, the buzzer will produce a sound in a certain time as a warning sign before the engine is turned off by the SOB; then, the SOB will cut the electricity at the key start fuse and the neutral start relay so that the engine will turn off completely.

Furthermore, measurements are made at a certain point to ensure that the addition of SOB devices to the unit's machine will not affect the performance of the electrical system, especially when the engine will be started (crank). Measurements were made by comparing the use of SOB and without SOB on the D3l Dozer unit.

CONCLUSION

From the research, it can be concluded that:

1. The design of the Service Operation Breaker (SOB) tool to control the rental time of heavy equipment units in order to minimize any fraudulent use of the unit has been done using an Arduino microcontroller device that is integrated with the D3K Dozer Caterpillar unit.
2. Measurement of the voltage and current when the engine is turned on and when the engine is started was carried out to see the effect of using the SOB on the D3K Dozer Caterpillar unit.
3. The measurement results show that the SOB is safe to use because it is still within the allowable stress range according to the literature.

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