Design Automatic Air Conditioning System Control with Passive Infrared Receiver/motion sensor

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ABSTRACT

Dr. Ferdinand Lumbantobing Airport faces serious challenges related to the waste of electrical energy in its operations. The quarterly report shows an inconsistent increase in electricity usage, which is largely due to human factors and some technical aspects. The biggest problem is the use of air conditioning and lights that do not need to be constantly active. This article takes a close look at the airport's efforts to address this waste of energy, focusing on the use of air conditioning and constantly burning lights in unused rooms. Measures such as monitoring, automation, sensors, employee extension, and smart appliance development are proposed to address these issues and achieve significant energy savings. This solution will help reduce airport operational costs, increase efficiency, and support environmental conservation.

Keywords: *Dr. Ferdinand Lumbantobing Airport, waste of electrical energy, efficiency.*

1. PENDAHULUAN

The increase in the use of electrical energy at Dr. Ferdinand Lumbantobing Airport is a problem that causes large expenditures, especially due to human factors that are inefficient in energy use. Factors such as increased air conditioning use, bad weather, and power outages affect energy consumption. This constraint resulted in increased airport monthly fees. From these data, Dr. Ferdinand Lumbantobing Airport (UPBU) seeks to reduce the use of electrical energy from PLN, the biggest example of electricity waste is the use of Air Conditioner (AC) air conditioning machines and lights that remain turned on even though they are not needed. In fact, AC electricity consumption is above 45%. So it is expected to make innovations that can help overcome electricity wastage. Like the example of the room I saw, namely the airport meeting room located in the main airport office, the room has 2 split air conditioners that continue to turn on outside operating hours and the room is not used. The air conditioner has a capacity of 2 PK which has an electric power of 1780 Watt.

When it is seen that the air conditioner is on for up to 24 hours in one day which means waste occurs at that time. With this, there is a desire to make tools that can overcome this and at the same time develop knowledge and experience in technological developments, especially in the field of airport electricity. The results of the review obtained, there was a desire to raise the problem with the idea of making a tool that helps in efforts to overcome the waste of electricity from air conditioners is not needed due to negligence that occurs in airport offices.

2. METHOD

The research method used is quantitative method. This method is a method of collecting survey data from the data collection process to its interpretation using many numbers or counting processes

3. RESULTS AND DISCUSSION

When collecting and taking data by conducting field studies / surveys to offices in the airport area and supported by theories from literature studies related to electrical installations that have been carried out. Accurate data is also obtained, namely the amount of electrical energy use at Dr. Ferdinand Lumbantobing Airport from January to March 2023 (Electricity bill payment receipt). In January it got 24,800.00 kWh, in February it was 25,644.00 kWh, and in March it was 26,144.00 kWh.

From these data, observations were made and saw that the AC office rooms were still on even though they were outside working hours. Like the example of the room I saw, namely the airport meeting room located in the main airport office, the room has 2 split air conditioners. The air conditioner has a capacity of 2 PK which has an electric power of 1780 Watt. It was found that the air conditioner was on for up to 24 hours in one day. So intend to compare the costs produced by the air conditioner when it lives up to 24 hours with living according to working hours and uses the calculation

formula: electric power (kWh) x usage time x cost. It was found that air conditioners that live 24 hours produce costs of IDR 61,717 per day and for a month IDR 1,851,527, - while the use of working hours (8 hours) IDR 20,572 per day and for a month IDR 617,175,-. From this calculation, a cost savings of IDR 41,145 per day and IDR 1,234,352 in a month were obtained on 1 AC 2 PK in the room and IDR 82,290 per day or 56.96 kWh and IDR 2,468,704 or 1708.8 kWh per month from 2 AC 2 PK in the room. In addition, thoughts also arise about the comparison of the use of electrical energy when the use of AC is turned off when not in use and turned back on when used (using ACS) by leaving the AC on until working hours are over (using Timer).

From the amount above, it greatly affects airport expenses per day and per month. The cost is still from one room and if all rooms experience the same thing, there will be considerable savings in airport expenses in terms of air conditioning use. From here innovate and take the initiative to make an Automatic Air Conditioning System tool in order to control the use of air conditioning so that it is expected to save electrical energy. From the problems obtained, a tool in the form of a sensor is made so that there is no waste of electricity that is wasted. With this sensor, the air conditioner will turn on and off automatically so that if no movement is detected in a room, the air conditioner will not turn on continuously.

a. Position Automatic Air Conditioning System (ACS)

The placement of the ACS sensor will be made in an office room which is a strategic place where there is always activity or movement and the sensor is easy to read the room situation. In addition, it also avoids the movement of animals or the room installed does not have animals.

b. How Automatic Conditioning System (ACS) works

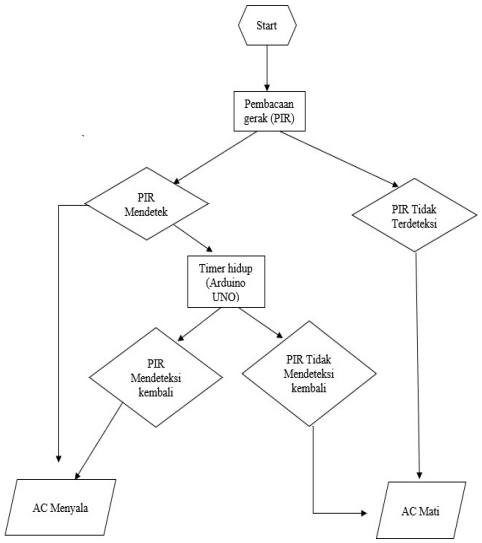

Figure 1 Flowchart Pengontrolan ACS

c. How Automatic Conditioning System (ACS) works

Observation and data collection were also made a comparison between the use of ACS and the default timer of the AC. From the observations made, using ACS will get additional current when starting or turning on the AC several times while when using a timer the current when starting only applies once when the user first turns on the air conditioner. The following is a comparison of the current needed when using ACS with Timer. In the experiment, the use of AC will last for 7 hours (airport operating hours) and ACS will turn on the AC from the extinguished position 3 times and the user leaves the room for 30 minutes 2 times and uses the formula E = V x I. From this observation it can be found that, When ACS is used, it is 68.1 Ah in 7 hours of use. When using a timer, a current of 72.8 Ah is obtained. It can be concluded that using AC by using an ACS control device saves more electric current by 4.7 Ah or 1,034 kWh in 7 hours of operation. It can be concluded that the use of ACS is more effective and efficient compared to the use of timers made during office operating hours.

Experimental Results

Here is a picture of a series of automatic switch projects using the HC-SR501 PIR created with *fritzing software*

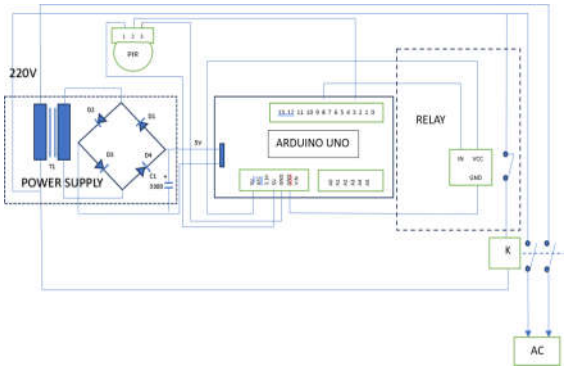

Figure 2 How to Install Control

How to install by following the picture, where the Arduino UNO gets voltage from the power supply as a voltage source. Then the Arduino UNO on output pin no. 8 is jumper to the relay input (IN1 section). Furthermore, at the output of Arduino UNO, pin no. 3 is jumper to the PIR component part 2 (Output). After that, the 5V voltage pin on the Arduino UNO is jumper to the pim voltage relay (VCC section), and the ground pin on the Arduino UNO is jumper to the ground of the relay. The NC (normali close) of the relay is connected to AC and the COM pin of the relay is connected to neutral adapter and the phase of the adapter is connected to AC. After that, the VCC (+5V) from the PIR sensor is jumper to the power supply to serve as a voltage source for the sensor and the ground of the PIR sensor is connected to ground from the power supply.

After the assembly process is complete, the next step is to test / conduct experiments. To start the experiment, there are 2 plugs that are given a voltage of 220V. the first plug to drain the voltage on the power supply which will be changed from 220V to 5V which is used to turn on all components of the sensor. The plug acts as a voltage multiplier of 220V to the load. After getting voltage, all components will turn on. If the PIR sensor gets a signal (movement), the relay will continue the voltage so that the load can turn on. Then if the PIR sensor does not read the signal (movement) again, the relay will disconnect the voltage that enters the load. After that, then turn on the control and test it with 3 different conditions to make sure the tool runs properly as shown below.

1. When Control Gets Source

The red indicator light on the Arduino UNO lights up and the green indicator light on the relay lights up and the green indicator light on the power supply will also light up.

Figure 3 Control Tests Get a Voltage Source

2. When the PIR Sensor reads movement

When in this condition, the indicator light on the relay turns red which means as NC (Normaly Close). Next, the air conditioner will turn on.

Figure 4 Motion Reading Control Test

3. When the PIR sensor does not read movement

In this condition, the indicator light on the relay is green. So if no movement is detected or no movement is detected again after the previous movement, the condition becomes NO (Normaly Open) or AC turns off / will turn off after the timer runs out.

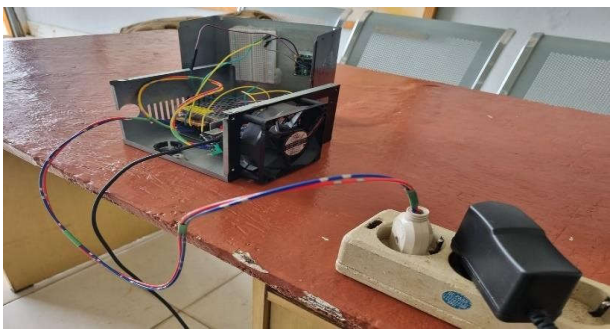

Figure 5 Control Test Does Not Read Gestures

4. CONCLUSION

The conclusions that can be drawn from this research are as follows:

1. One of the efforts that can be made to overcome the use of AC electronic devices that continue to turn on due to negligence so as to waste the use of electricity at the airport office.
2. The sensitive PIR component will capture movement signals in a room so that it commands to turn on the air conditioner and will turn it off if no movement is detected. This can make it easier for humans to carry out activities in the office and can overcome waste that should not be needed.
3. Applying ACS control can also maintain the durability of AC so that its use can be in the long term.

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