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Arduino Uno Microcontroller Application for Single Phase Electric Thief Monitoring

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Abstract— *One of the efforts to overcome the theft of electricity is to carry out Controlling the Use of Electricity (P2TL). But this is not done optimally because the number of officers is lacking. To overcome this, a tool is needed for monitoring areas prone to theft of electricity so that the work of P2TL can be maximized. The tool used utilizes the Arduino Uno Microcontroller as the Control center, the ACS712-20A current sensor to detect the amount of current entering the equipment, the keypad as an input to set the maximum current, LCD to display the maximum current, and LED lights to indicate if a disturbance occurs. By comparing the current from the mapping results of the meter record employee with the maximum setting current on the equipment, it will be known that the condition of the low-voltage network is being stolen or not.*

Keywords: Arduino Uno ,Microcontroller, Current Sensor ACS712-20A

1. INTRODUCTION

As a result of the illegal use of electricity, which is commonly known as electricity theft, is the loss of the state electricity company and the emergence of disturbances in the electric power network due to loading that exceeds its capacity. This disturbance results in blackouts that affect the continuity of electricity distribution.
To overcome this, it is necessary to install equipment that is useful for monitoring areas prone to theft of electricity. This equipment is useful for reducing direct monitoring activities carried out by officers. By utilizing meter record officers to record customers at certain locations, a mapping of the use of electricity consumption can be carried out. After the data collection has been carried out, monitoring of the theft of electricity can be carried out by comparing the current in the data collection with the current measured in the monitoring equipment. This equipment is a unit of several equipment that work together to monitor the theft of electricity. The equipment is the Arduino Uno Microcontroller as the Control center, the ACS712-20A current sensor to detect the amount of current entering the equipment,

2. DESIGN METHOD

2.1 Arduino Uno

Arduino uno is a type of microcontroller circuit that uses aphysical computing. Physical computingis to create a system or physical device using software and hardware that is interactive, that is, it can receive stimuli from the environment and respond back. Physical computing is a concept for understanding the human relationship between an environment whose nature is analogous to the digital world.

2.2 ACS712-20A . current sensor

The ACS712 sensor is Allegro's production for an economical solution in measuring both AC and DC currents. In principle, the ACS712 current sensor is the same as other hall effect sensors, namely utilizing the magnetic field around the current which will be converted into a linear voltage with changes in current. The voltage generated by the current sensor is a variable voltage. This variable voltage value will enter the microcontroller.

Figure 1. ACS712-20A

2.3. LCD

The LCD module is one of the tools used as a display. The M1632 is a liquid crystal display dot-matrix module with a 16 x 2 row display with low power consumption. This LCD module is equipped with a controller chip specially designed to control the LCD, functions as an LCD driver and character generator

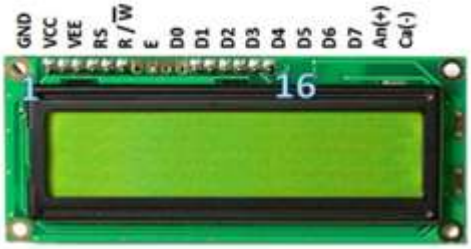

Figure 2. 16 x 2 . LCD pin configuration

2.4. Keypad 4 x 4

Byhardware, the keypad is a collection of keys that form a matrix. With n rows xn columns. The 4×4 matrix keypad forms a matrix of 4 rows x 4 columns, using 8 pins for 16 keys. This is possible because the series of buttons are arranged horizontally to form rows and vertically to form columns.

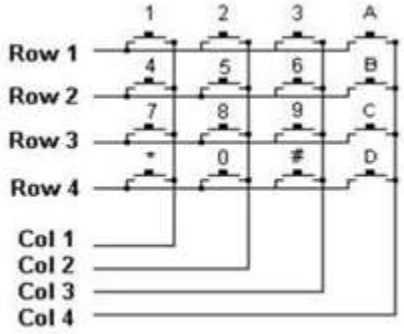

Figure 3. 4 x 4 . keypad circuit

2.5 Sensor design

This sensor module is ACS712-20A current sensor. In this module there are several electronic components that have a function to convert the amount of current into an electric quantity in the form of direct voltage. The electronic circuit of the current sensor can be seen in the following figure.

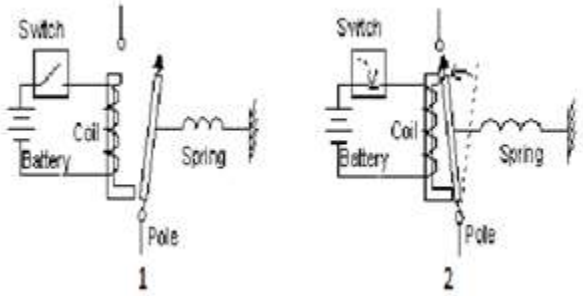

Figure 4. Current sensor module

2.6 Switch Circuit Design

The switch circuit is used to turn on the LED lights as an indication of the theft of electricity. The switch circuit consists of a 1 kΩ resistor 9014 transistor and a 5 VDC 8 pin relay. The resistor is connected to pin 2 of the Arduino and to the base of the transistor. Resistors are used to divide the current entering the transistor.

2.7 Power Supply Design

Fixed power supply is a power supply circuit that produces a fixed and stable output voltage. To get a steady power supply, you can use a dry battery or a rectifier circuit equipped with a stabilizer. The power supply in this circuit serves to convert the AC voltage of 220 V into a voltage of 9 VDC. The power supply is composed of a step down transformer, rectifier diodes, electrolytic capacitors, and IC LM7809.

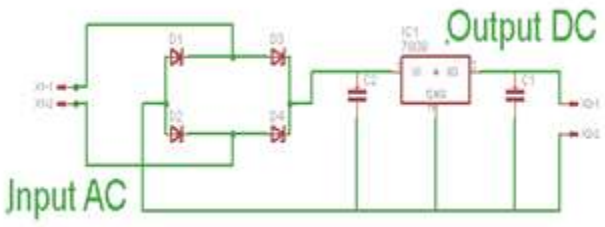

Figure 5. Rectifier circuit

3. SYSTEM TESTING AND ANALYSIS

3.1 Current sensor testing

The current sensor circuit uses ACS712-20 A as the main component. The current measured is the effective current or Irms. In the test, the author took several samples of the load with the first material of 40 W of power which was carried out for 5 experiments. This is intended to find out how much the increase in the ADC conversion results for each 40 W load increase with the sensor input voltage of 5 VDC.

Table 1. Current Sensor Experiment Table

Power (Watt)	ADC	ΔADC	current (A)	Δcurrent (A)
40	516		0.1	
80	520	4	0.2	0.1
120	524	4	0.3	0.1
140	528	4	0.4	0.1
180	532	4	0.5	0.1
average		4	0.1	

As a reference for current testing, a Kyoritsu multimeter was used using 5 tests with a power increase of 40 W. The current test results are shown in the following table.

Table 2. Current Sensor measurement comparison with Kyoritsu multimeter

Power (W)	Multimeter (A)	Tool (A)	Error
40	0.11	0.1	0.01
80	0.2	0.2	0
120	0.3	0.31	0.01
140	0.42	0.4	0.02
180	0.53	0.51	0.02
average error			0.012
Standard deviation			0.00837

3.2 Power Supply Test

Testing on the power supply circuit aims to measure the amount of voltage required by each circuit block. The voltage required by the system ranges from 5-20 VDC, and the manufacture of this power supply takes a voltage output of 9VDC. After measuring, the output of the impure power supply circuit is 9V, which is only 8.8 -8.9 VDC. Although less than 9 VDC the system is still running normally because the required voltage still meets the standard.

3.3 Microcontroller circuit testing

1. The output voltage of the 5V pin microcontroller circuit: 5 volts
2. Output voltage of the 3V3 pin microcontroller circuit: 3.3 volts

3.4 Keypad and LCD testing

TestKeypadand LCD is done by connecting the keypad and LCD pins to the pins on the microcontroller. The test is carried out by paying attention to the buttons pressed on the keypad whether they are in accordance with what is displayed on the LCD. By turning on and filling out the scanning program on the microcontroller, pressing the keypad will generate the data for each key press as follows.

3.5 Switch test

The test is carried out by connecting the switch circuit to pin 2 of the Ardino Uno. By giving the command outputHIGHin the program will cause the relay contacts to move from initially normally open to normally close. This shift will turn on the LED light which is used as an indication if there is a theft of electricity.

3.6 System Test

Entering inputsettingsthe maximum setting current is in accordance with the data obtained from the meter recording officer. For this test, it is not based on direct data, only a maximum input setting of 2 A is entered.

The following is the data on the amount of load given

Table 3. Simulation test using 6 houses

House	Load (watt)	current (A)
1dan 2	350	1.1
3 dan 4	40	0.1
5 dan 6	40	0.1
Total	Load =390	current=1.3

Of the six houses, the system has not detected any theft of electricity because the total current is less than the maximum current setting. After adding one more house, the system detects the theft of electricity, because the total current exceeds the maximum current setting. The total current and power of the seven houses can be seen in the following table

Table 4. Simulation test using 7 houses

House	Load (Watt)	Current(A)
1dan 2	350	1.1
3 dan 4	40	0.1
5 dan 6	40	0.1
7	350	1.05
Total	Load =780	Current=1.35

4. CONCLUSION

The circuit for monitoring areas prone to theft of electricity uses the Arduino Uno Microcontroller as the control center, ACS712-20A current sensor to detect the amount of current entering the equipment, the system can only be used for loads less than 20 Ampere. The ACS712-20A current sensor is connected in series to the load to perform AC current measurements. When there is current flowing, the ACS712-20A current sensor will produce a DC voltage which for every 1 Ampere increase the sensor output voltage increases by 100 mV. Input data officer record meter is used as setting the maximum current. the maximum current setting will be compared with the measured current to determine the condition of a single-phase low-voltage network is electricity theft or not. If the measured current exceeds the maximum current setting, the system will detect this and will turn on the LED light as an indication that electricity theft has occurred. If the measured current is less than the maximum setting current, the system will state the condition is safe or there is no theft of electricity.

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