



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ELECTRIC PROFILER SYSTEM USING ARDUINO

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Computer Engineering Technology (Computer Systems) (Hons.)

by

NUR MASTURINA BINTI ROSLAN

B071310611

940309035448

FACULTY OF ENGINEERING TECHNOLOGY

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DECLARATION

I hereby, declared this report entitled “Electric Profiler System using Arduino”
is the results of my own research except as cited in references.

Signature :

Author’s Name : Nur Masturina Binti Roslan

Date :

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor's in Computer Engineering Technology (Computer Systems) (Hons.). The members of the supervisory committee are as follow:

.....
(HASRUL'NISHAM BIN ROSLY)

.....
(MISS ROSZIANA BINTI HASHIM)

ABSTRAK

Baru - baru ini, takrif baru telah diperkenalkan oleh Tenaga Nasional Berhad (TNB) kepada para pengguna. Untuk kegunaan domestik, terdapat lima peringkat takrif penggunaan elektrik. Sebagai contoh, peringkat pertama penggunaan elektrik adalah dari 0 kWh sehingga 200kWh di mana pengguna akan dicias sebanyak RM 21.80. Jika pengguna cuma mengguna sebanyak 150 kWh, mereka juga perlu membayar bil sebanyak RM 21.80. Oleh itu, ianya memberi keburukan kepada pengguna kerana mereka tidak tahu bil yang tepat sehingga mereka menerima bil pada setiap hujung bulan. Jika para pengguna mengetahui jumlah penggunaan elektrik, mereka boleh mengawal kegunaan dan bil. Dengan itu, sistem profiler elektrik menggunakan Arduino telah dibina untuk pengguna melihat kegunaan elektrik yang terkini di rumah mereka. Alat elektrik profiler sistem ini adalah salah satu alternative untuk menghalang para pengguna untuk membayar bil lebih. Projek ini dapat membantu pengguna untuk jimatkos dan penggunaan elektrik. Terdapat banyak kes di mana pegawai – pegawai Tenaga Nasional Berhad (TNB) akan memeriksa meter terkini dengan andaian penggunaan yang lebih tinggi berbanding bulan sebelumnya. Jika tidak, Tenaga Nasional Berhad (TNB) akan rugi dan disebabkan itu, para pengguna yang perlu menanggung akibatnya. Ini adalah bagaimana terciptanya idea membina sistem elektrik profiler sebagai projek. Sistem ini terbahagi kepada dua bahagian iaitu reka bentuk perkakasan dan perisian. Rekabentuk perkakasan melibatkan Arduino UNO, jam masa nyata, paparan LCD dengan I2C siri dan ACS712 elektrik sensor. Untuk perisian, pengkodan untuk perkakasan komponen telah dipasang di dalam Arduino UNO. Mesej “Electric Profiler” akan muncul di skrin selepas itu mesej “Welcome”. Kemudian, apabila suis dihidupkan, ACS712 elektrik sensor akan mngesan arus elektrik and menghantar data kepada Arduino UNO. Kemudian, Arduino akan menukar data kepada bil untuk pengguna di mana LCD akan paparkan. Jumlah penggunaan elektrik pula akan dipaparkan sebelum bil dipaparkan.

ABSTRACT

Currently, the new tariffs of Tenaga Nasional Berhad (TNB) is been introduced to the users. For the domestic, there are five types of tariffs range of electricity usage. For example, the first range is from 0 kWh until 200kWh, where the user is been charged for RM21.80. If the users used only 150kWh only, they also need to pay the bill for RM21.80. This is disadvantages for the user because they do not know the accurate bill until they received the electricity bill the end of the month. If the users know total amount the usage of electricity, they can control the usage and the bill as well. Thus, the electric profiler system using Arduino is being built for the user to monitor the current usage of electricity at their household. This electric profiler system device is an alternative path to prevent the users to pay the electricity bill more. This project helps the user to save cost and the usage of electricity. There are cases where the officers of Tenaga Nasional Berhad (TNB) check the current meter by assuming the meter from far. Then, the actual electricity usage is not been calculated correctly. It is harm to the users whose they need to pay more from the actual bill due the officers assume the usage is higher from the last month. If not, the Tenaga Nasional Berhad (TNB) will be loss and because of that, the users need to pay the consequences. This is how the electric profiler system device is being an idea to the project. This system was divided into two parts, which are the hardware design and software implementation. The hardware design involved the Arduino UNO, real time clock, LCD display with I2C serial and ACS712 current sensor. For the software implementation, the coding for the hardware component is being installed in the Arduino UNO. The message of “Electric Profiler” is appeared on the screen then the “Welcome” is displayed after. Then, when the switch is being on, the ACS712 current sensor detected the current and sent the data to the Arduino UNO. Thus, the Arduino converted the data into the bill for the user that display on the LCD display. The total of electric usage also been display on the screen before the bill is appear

DEDICATION

Every challenging works need self-efforts as well as guidance of elders, especially those
who were very close to our heart.
My humble effort I dedicate to my sweet and loving

Father & Mother,

Whose affection, love, encouragement and prayers of day and night make me able to get
such success and honour

Along with all hardworking and respected

Lecturers

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TABLE OF CONTENT

Abstract	i
Table of Content	ii
List of Tables	iii
List of Figures	iv
CHAPTER 1: INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	1
1.3 Objectives	2
1.4 Scope	3
1.5 Outline	4
1.6 Conclusion	5
CHAPTER 2: LITERATURE REVIEW	6
2.1 Introduction	6
2.1.1 Arduino	7
2.1.2 ACS712 current sensor	8
2.1.3 Real Time Clock (RTC) chip	11
2.1.4 Liquid Crystal Display (LCD) 1602	12
2.1.5 I2C serial bus	12
2.1.6 Smart Meter Energy	13
2.2 Past Related Researches	15
2.2.1 Findings by others and similar projects	15
2.3 Summary	18
CHAPTER 3: METHODOLOGY	19
3.1 Project Development Process	19
3.2 The Architecture of System	21
3.3 Design Components	22

3.3.1	Arduino Board	22
3.3.2	Arduino Proramming	22
3.3.3	Flowchart	23
3.3.4	Prototyping methodology	25
3.4	Hardware Design	26
3.4.1	Arduino Board	26
3.4.2	ACS712 Current Sensor	27
3.5	Software Design	28
3.5.1	Arduino program for Arduino Board	28
3.5.2	ACS712 Current Sensor programming	29
3.6	Electric Profiler	30
3.7	Budget and costing	30
3.8	Summary of Methodology	31
 CHAPTER 4: RESULT AND DISCUSSION		32
4.1	Introduction	32
4.2	Development of Phase	32
4.3	Hardware Implementation	32
4.3.1	ACS712 Current Sensor	33
4.3.2	Arduino UNO and ACS712 current sensor	34
4.3.3	Arduino UNO and real time clock	36
4.4	Software Implementation	37
4.5	Result	38
4.6	Coding Implementation	39
4.6	Discussion	42
4.6.1	Limitation of study	42
4.6.2	Problem Encountered	42
 CHAPTER 5: CONCLUSION		43
5.1	Introduction	43
5.2	Conclusion	43
5.3	Recommendation	43

5.4	Project Potential	45
	REFERENCES	46
	APPENDICES	49
A	Gantt Chart	50
B	Coding of ACS712 Current sensor	51
C	Coding of real time clock	52
D	Coding of LCD1602 display with I2C serial	53
E	Coding of electric profiler system	54

LIST OF TABLES

2.1	Comparison between single and three phase of power meter pulse	10
2.2	Comparison utility meters	14
2.3	The summary of research of literature review	17
3.1	Direct cost of electric profiler system	30
4.1	Pin connection of ACS712 current sensor	34
4.2	Pin connection of real time clock	36

LIST OF FIGURES

1.1	Project Block Diagram of Electric Profiler	3
2.1	Project Block Diagram of Electric Profiler	6
2.2	Arduino UNO	7
2.3	ACS712 Current Sensor	8
2.4	Illustration of Half Effect Principle	9
2.5	Connection configuration of ACS712 current sensor with Arduino, load and power supply	10
2.6	Front of Real Time Clock	11
2.7	Back of Real Time Clock	11
2.8	LCD display 1602	12
2.9	I2C serial of LCD display	12
2.10	I2C serial is attached with LCD	13
2.11	How the smart meter works	13
3.1	Overview Architecture	21
3.2	Flowchart of the Electric profiler system part1	
3.3	Flowchart of the Electric profiler system part2	24
3.4	Prototyping methodology	25
3.5	Block Diagram of electric profiler	26
3.6	Arduino Board	26
3.7	Interfacing Arduino UNO and ACS712 current sensor	27
3.8	Example of Arduino code of myMultiiplyFunction()	28
3.9	Example of ACS712 current sensor	29
4.1	ACS712 Current Sensor	33
4.2	Arduino UNO connected to the CAS712 current sensor	34
4.3	The connection between Arduino UNO, ACS712 current sensor and wire	35
4.4	The connection between Arduino UNO and RTC	36
4.5	Header File	37

4.6	The front of the electric profiler system device	38
4.7	The electric profiler system device	38
4.8	Coding of ACS712 current sensor	39
4.9	Coding of real time clock	40
4.10	Coding of LCD with i2C serial	41

CHAPTER 1

INTRODUCTION

This chapter discussed about the background, problems statement, objectives and scope of the project.

1.1 BACKGROUND

Electric profiler system is a project that displays the total amount of the electric bill to users in kWh or kW. By using this system, the user will know the amount of the electric bill used accurately without need to predict the amount to pay every month. Thus, ACS712 current sensor is uses to measure the current or electric that flow through the plug. Then, Arduino get the data and the current is converted to price in Ringgit (RM) and it will be displayed at the computer.

1.2 PROBLEM STATEMENT

This project is an alternative way to overcome the billing system. Normally, user needs to wait until the end of the month to know the amount of the electric bill from Tenaga Nasional Berhad (TNB). There are several disadvantages of this system. Lately, the officers check the current meter by assuming the meter from far. It is either he is bothers to ask permission from the user to look at the meter or lazy to ask. Due this problem, the officers assume the meter higher than the actual meter that cause the higher bill for user. They do not bother the amount of bill because the users pay the bill.

In certain case, the user is not at home and the meter is inside the house or it is too far from the main gate. For the housing area, the distance between the gate and the meter is not too far. But for the bungalow, villa and other big house on their own land, the officer needs to enter first and check the meter. In other case, the crime is increase and the criminal pretends they are the officer from

Tenaga Nasional Berhad (TNB) to rob and rape. This makes the officers duty more difficult without the user cooperation.

Thus, to avoid this kind of problems, the electric profiler system created. By using this device, the users can calculate the electricity by themselves manually. The electric profiler device is easier to control the power consumption. Through this device, users can monitor the electricity consumption every day and every moment. When the user feel the usage of electricity is uncontrolled, they can decrease the usage of electricity. Being able to monitor the electricity consumption provides extremely valuable insight in the effort to conserve the energy.

1.3 OBJECTIVES

Objectives are the goals to be achieved at the end of the project or study. Each project has objectives that keep the project on the right path and become more clearly to define. There are only two objectives that are determined of this project and required to be achieved. The objectives of this project are as below:

1. To study electricity system and rate in Malaysia
2. To design the electric profiler system device using Arduino
3. To implement electric profiler system in daily usage

For the first objective, this project is to study electricity system and rate in Malaysia. This can help how to calculate the power consumption used using the tariffs of Tenaga Nasional Berhad (TNB)

Besides that, for the second objective, this project focuses on the design of the electric profiler that able to detect current flow that has been used and calculate it then, convert it to the price in Ringgit Malaysia. By using the current sensor, this electric profiler can detect the current and send the data to the Arduino and will be display on the LCD display.

1.4 SCOPE

This project is the electric profiler system using the ACS712 current sensor to detect the current flow. The scope of work for this project is to cover cases study through literature reviews and journals on the Arduino UNO microcontroller and ACS712 current sensor.

In addition, the scope of this project is development of electric profiler system. Users can monitor the electricity in certain time they want. Furthermore, this project will be focused on two features which are software and hardware part.

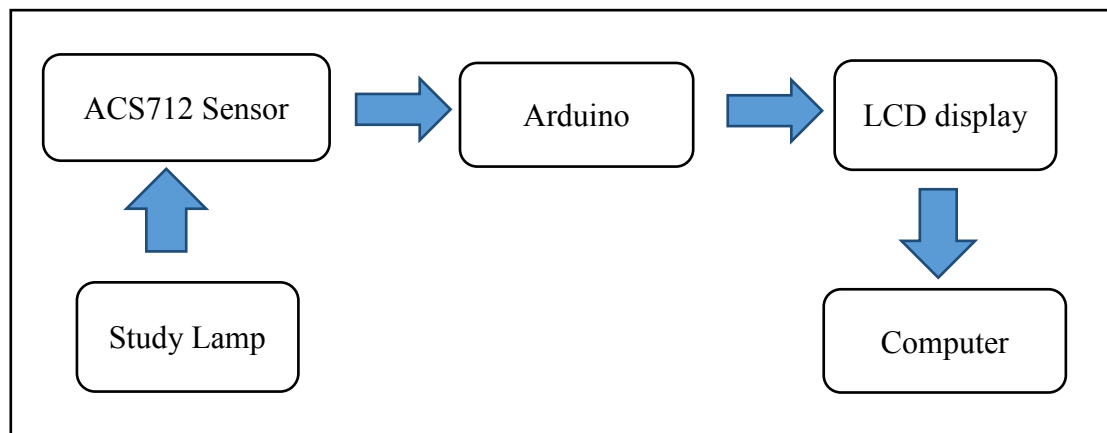


Figure 1.1: Project Block Diagram of Electric Profiler

Firstly, the software part is responsible to make the programming code for the Arduino circuit. For the coding, the C++ AND Java will be used where the Arduino software is in C++ programming.

In hardware part, the ACS712 current sensor is used to measure the current or electric that flows then, Arduino get the data and the current is converted to price in Ringgit (RM) and it will be displayed at the computer. Arduino is the open source that is easy and simple to be used for building the electronics projects. Arduino also consists both of the microcontroller which is the physical circuit and software, or IDE (Integrated Development Environment) that runs on the computer, which is used to write and upload computer code to the physical board.

1.5 OUTLINE

This project is consists of five chapters. In chapter I, the project overview the objective, scope of work and problem statement that are briefly discussed which purposely to provide the understanding of the project introduction.

Chapter II, the related researches as literature review of the project which includes the concept, theory, perspective, and the method of the project that is used in order to solve the problem occurs and any other that related with the research of methodology.

Chapter III is about the research methodology of the project. This chapter will discuss the method or approach that used in project development.

Chapter IV is the discussion on the observation, result and the analysis of the project during the development of project. This chapter also consists of the recorded data analysis and the result of the project.

Chapter V covers the discussion of whole contents of the thesis and project development.

Chapter VI discusses the suggestion for improvement process in the future research and overall conclusion of the project.

1.6 CONCLUSION

Full understanding of the project research will assist students to gain more knowledge on the project structure and to move a step forward in starting the project development. At the same time, limitation on scope shall encourage student to explore more in the future work. The introduction chapter covers the background, problem statement, objective and scope. With all the information provided above, it highlights a brief outline of this project report and reader will understand the basic idea of the electric profiler system. So, in Chapter 2 which is literature review, it explains the Arduino, ACS712 current sensor and previous similar project. The approach and method applied in this project are present in the Chapter 3 which is methodology. Last but not least, the results and discussion will cover in Chapter 4 while the last chapter will covers the conclusion and recommendation.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the theory will be discussed regarding this project, which reveals the knowledge that gained via resources from reference book, journal, articles, newspapers, and websites that contain application, research work, and related theories. The study is very necessary in order to gain more knowledge and understanding of smart energy meter, Arduino, ACS712 Current Sensor and related research, and existing technology of research that contains similarity to the project. This chapter presents a review of related works in the electric profiler using Arduino.

2.1 Introduction

Electric profiler is known as a device to measure the power consumption that has been used. By measuring the power consumption is the way to save cost. Every house of the residence has a house meter that shows the total power consumed. Furthermore, the house meter is placed where the officer is convenient to read. This electric profiler can help user to measure and record the electricity in the house. The simple electric profiler requires Arduino circuit and ACS712 current sensor for more convenient to receive and display the information. Some house meters record data every second but using the sensor the data recorded min every 30 seconds.

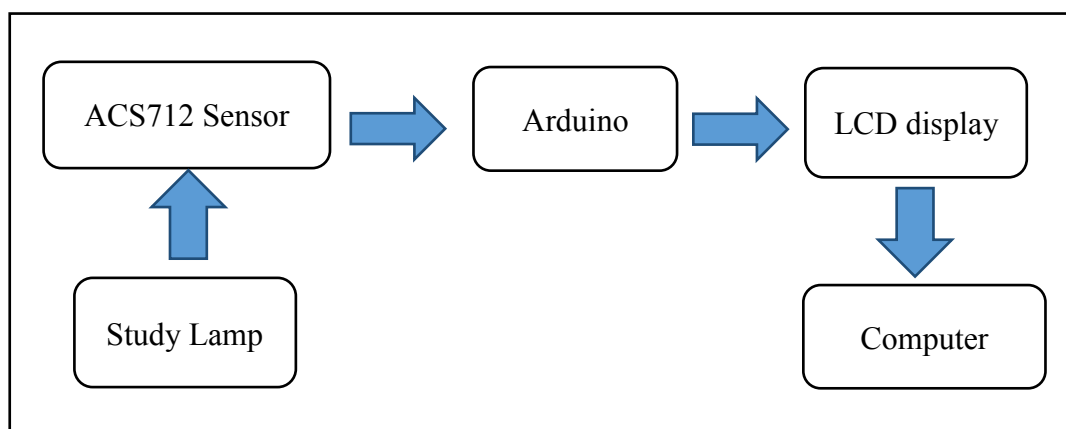


Figure 2.1: Block diagram of electric profiler

2.1.1 Arduino



Figure 2.2: Arduino UNO

Arduino was created at the Ivrea Interaction Design Institute as an easy component or circuit that fast prototyping aimed for students without the background in electronics and programming. Arduino is the open source prototyping that easy to use in hardware and software. Arduino are able to read input, the light sensor, finger on the button and turn it into an output activating a motor, light on the LED or publishing online. But, Arduino programming language and the Arduino software (IDE) required to use. The Arduino software is easy to use for beginners where it runs on Mac, Windows and Linux.

Nowadays, the Arduino as shown in the Figure 2.2 is the open source electronic prototyping based on the flexible, easy to use whether in hardware or software. It is intended for artists, designers or anyone who are interested in creating interactive objects or environments. By using Arduino, almost anything can be built from a simple project to complex and complicated project. On the other hand, Arduino is made up to be hooked to sensors that connected with it physically. It is more popular because it is cheaper and easy to learn to write the coding and the beginners can search and download the program for the board. In the Arduino, it runs Java on Mac OS, Windows and Linux. Arduino board are able to read he inputs such as lights on a sensor, a finger on the button and so on and turn it into the output that activate a motor, turning the LED on and so on.

This project uses Arduino UNO microcontroller because it is relatively cheap, plugs straight into the computer's USB port and simple to setup and use compare to other development boards. It is an open source design that many people is used and easy to find someone to help debug the project. The Arduino board is designed as circuit board for programming and prototyping with Atmel microcontrollers. There is button to reset the program on the chip.

2.1.2 ACS712 Current Sensor



Figure 2.3: ACS712 Current Sensor

ACS712 current sensor is the Hall-effect principle that discovered in 1879 by Dr. Edwin Hall. When the current carrying conductor is placed into magnetic field, the voltage generates across the edges perpendicular to the directions of both current and the directions of both current and magnetic field. Half Effect principle also, a production of voltage difference which is Hall voltage across an electrical conductor, then transverse to current in the conductor and magnetic fields is perpendicular to the current. Figure 2.4 shows that the illustration of the half effect principle.

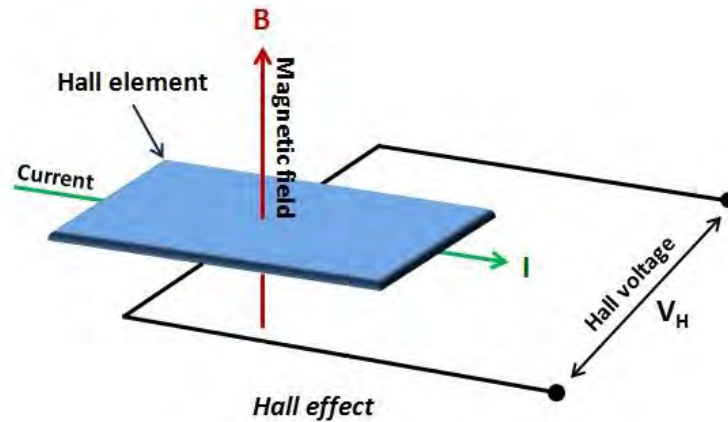


Figure 2.4: Illustration of Hall Effect principle

Hall element is the thin sheet of semiconductor carrying the current (I) and placed into the magnetic field (B) that perpendicular to the direction of current flow. There is the presence of the Lorentz Force so, the distribution of current is no more in uniform that across the Hall element. Thus, the potential difference across the edge of the perpendicular is created to the directions of both current and field that known as Hall Voltage. The value is in the order of the microvolts. The Hall Voltage is directly proportional to magnitudes of current (I) and magnetic field (B) thus, either current (I) or magnetic field (B) is determined, the Hall Voltage can estimate the other.

ACS712 current sensor provided in a small size, it surface mount SOIC8 package. It consist linear Hall sensor circuit with copper conduction path that located near the surface of the die, low off-set and precise. The ACS712 current sensors are designed to use with the Arduino microcontroller easily. This sensor is based on the Allegro ACS712ELC chip.

Advantages of ACS712 current sensor:

- ACS712 current sensor is Half effect sensor
- Nearly not affect the measured current
- Can be placed or located anywhere on the current path thus, it is easy for installation

- Considered non-intrusive because no significant amount of resistance is inserted into the current path, and thus the circuit being measured behaves almost as if the sensor is not present
- Regarding accuracy, currently available Hall effect sensors can achieve output error as low as 1%
- Can be used for both AC and DC current measurement

Single phase power meter pulse sensor	Three phase power meter pulse sensor
Usually each pulse equals one Wh (1000 pulses per kWh)	Each pulse corresponds to greater amount of energy
Generally the cheapest and easiest way to collect energy data, because they can be attached to existing smart meters	Generally the cheapest and easiest way to collect energy data, because they can be attached to existing smart meters

Table 2.1: Comparison between single and three phase of power meter pulse

ACS712 current sensor can detect both AC and DC current and designed for three current ranges which is 5A, 20A and 30A. ACS712 current sensor consists of integrated circuit that works used the half effect principle.

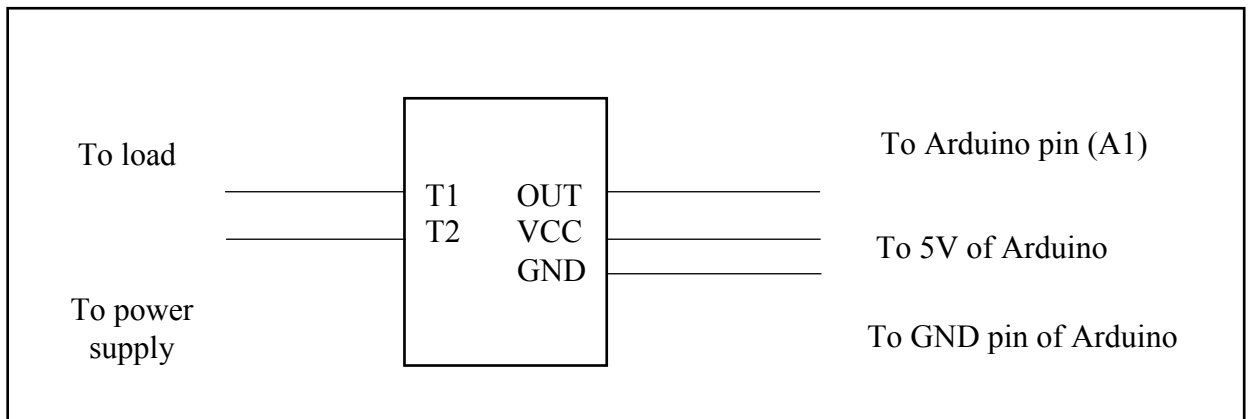


Figure 2.5: connection configuration of ACS712 current sensor with Arduino, load and power supply.

T1 and T2 pin at the ACS712 current sensor need to connect in series with the current path to detect the current later. OUT pin is connects to the analog input pin on the Arduino board

while VCC is connects to the 5V pi on the board and GND is connected to GND on the Arduino.

2.1.3 Real Time Clock (RTC) chip



Figure 2.6: Front of Real Time Clock



Figure 2.7: Back of Real Time Clock

Real-time clock is to measure the time, even though the main device is turn off. Real Time Clock can draw power from battery or super capacitor. Mostly, in real time clock the power consumption is the factor, but accuracy and small package size are also to be considered. Nowadays, Real Time Clock reduces the package pin count by supporting a serial interface. The real time clock is basically same as watch which it runs on battery and keeps time even though the power is outage. In addition, if the program in the microcontroller is being reprogrammed or disconnect it either from USB or power plug, the long timelines can be track. Mostly, microcontroller such as Arduino has their own built-in keeper that called millis () and timer built in the chip that can trace the longer time period like minutes or days.