



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 13, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com



Prevention of over Current Consumption through IOT

¹Dr. Swapna S, ²D.Lavenya

Department of EEE, GRTIET, Tiruttani, Tamilnadu, India

Department of EEE, GRTIET, Tiruttani, Tamilnadu, India

ABSTRACT: With the development of national economy, the demand for electricity from all walks of life has been gradually increased. People also put forward higher requests to the reliability of power supply. The efficiency of power systems is largely determined by the effectiveness of the inbuilt power equipment. Monitoring over load condition and quick isolation of the system from faults helps to improve the efficiency of the power systems reliability. Electrical equipment is prone to disturbances which are fault imposed on the system such as overloading and short circuit. To overcome these challenges, a continuous monitoring and earth fault detection system using IOT technology is proposed. The system is continuous monitor the current which is consumes by the load. Those current values are exceeds the limit then trip the circuit.

KEYWORDS: Power consumption estimation, ground faults, voltage protection, power outlet, loads and overload protection

I. INTRODUCTION

Nowadays, the applications of smart home concepts and home energy management systems (HEMS) have been gaining increasing attention in the research community due to many advantages they offer. These technologies aim to facilitate users' operation and management of household appliances to operate automatically and optimally. Furthermore, they represent a crucial step in achieving energy efficiency. To build such management systems, it is necessary to identify and control the energy consumption of major [1].

Rapid technological developments, so that electronic devices are made and designed to help human needs in everyday life. Electronic devices are very easy to find in human life, so the presence of electronic devices helps human work to be faster, more efficient, and effective. The use of electronic devices certainly requires electrical energy supply and by Law No. 30/2009 concerning electricity regulating the increase in electricity tariffs in households and small industries due to the removal of electricity subsidies. As many as 23 million Indonesians enjoy subsidies provided by the Government. The use of electricity with a capacity of 900 VA by paying Rp. 575 per kiloWatt hour (kWh), then the government added a subsidy of Rp. 876 per kiloWatt hour (kWh) [2]. The major aim of the topic is to perform energy management and load monitoring of given loads connected to a system. More specifically, demand side or consumer side energy management is of predominant concern and focus. Several of the connected loads are non-intrusively monitored through Hidden-Markov Model and their energy consumption is calculated. Thus, the name Non-Intrusive Load Monitoring system [3]. The overload control problem of passenger ship is actually a problem of "personnel count". In fact, there are a lot of traffic control problems in public places such as vehicle overload control, shopping malls, airports, stations and so on, and relevant experts and scholars have put forward a large number of technical solutions to this problem, and formed a lot of mature products: In shopping malls and other public places, mainly using remote sensing images to statistics the law of passenger flow. Or install image capture system in public places for face acquisition, performs face detection based on deep learning [4]. Smart house systems are becoming omnipresent in almost every household. The idea behind smart house systems it the integration of home automation or building automation interconnected with online services. The proposed systems results conclude that by using a combination of low cost microcontroller and IOT a cost effective and user friendly system can be designed for the purposes of monitoring power consumption at various locations within the household and power network. [5]. However, despite the popularity of smart house systems in this time of recession customers in residential buildings can rarely afford the costly prices of a smart home system. Further on, various smart home systems use Radio Frequency (RF) medium for data transfer requiring the confirmation of the regulatory agencies for the use of these devices, making them



inapplicable in different countries. All of these drawbacks must be taken into account in planning and designing a smart house system.

On the other hand, in the times of recession majority of users are starting to focus solely on the power consumption monitoring and the safety of their homes, so a compromise must be made between expensive smart house systems and a cost effective system with limited yet fully adequate power metering functionality. [6].

II. PROPOSED SYSTEM

In the proposed project, we are monitoring the load usage of the house continuously by using current sensor and the details of the current sensor will be sent to the microcontroller. Now the microcontroller will check whether the current consumption goes beyond the threshold value and if that happens then power supply will be trip down to the particular house. On overload condition the relay will trip the total circuit and buzzer will be on to Indicate over load and the status will be displayed in the LCD.

In addition to that we are also monitoring the earth fault by using voltage sensor in the feeder and the ground voltage readings will give to the microcontroller and if the microcontroller finds the abnormal readings in the feeder then it will upload in the web server as earth fault occurred with location by using the IOT communication.

2.1 Basic Theory

A. Study of Literature

Research related to the electrical power monitoring system conducted by Riny Sulistyowati aims to control and limit the use of electrical energy in electronic devices, using current and voltage sensors. From the results of these studies obtained from tests conducted in the room resulted in an error at a current of 4.88% and an error at a power of 2.76% .

Research conducted by Irwan Dinata with the title Implementation of Web-Based Wireless Energy Electricity Monitoring Database. This study aims to replace the electrical energy measurement system manually and conventionally. This study uses four main parts, namely sensors, processors, displays, and networks. The sensor section consists of the Current Transformer and AC to AC Power Adapter. Then the processor is used by Arduino UNO to process the work on the sensor. The display displays real-time output data. Whereas the network consists of 3G Router, Ethernet Shield, 3G Modem as communication to the Database Server for data storage and processing. From the test results with a load of 120 Watt shows the results of Vrms displayed on the LCD of 218 Volts, the measurement results of the Clamp Meter of 216 Volts. While the flow shows the results of the IRMS of 0.44 amperes, the measurement results of the Clamp Meter of 0.5 amperes. Also, this research succeeded in sending measurements at any time to the Database Server on the Wireless energy Monitoring application that has been designed.

B. Characteristic of PLN Resources

PLN electricity source is the source of electrical energy obtained from Alternating Current generators (AC) power plants such as Steam Power Plants (PLTU), Electric Power Plants (PLTD), or other power plants that produce alternating current [3].

Voltage and Alternating Current

AC electricity produces currents and voltages with values of magnitude and polarity that change periodically, with sine waveforms drawn. At the PLN power source in the form of sine waves, while square and triangle waves are widely used in inverters.

Voltage and Current RMS

Alternating voltage and current are usually expressed in terms of RMS (Root Mean Square) values. RMS itself is usually known as the average square, which is a statistical measurement of magnitude having a change in magnitude. Calculating changes in voltage and current in a sine can be calculated by equation 1.

$$V_{rms} = \frac{1}{2} A \quad (1)$$

A = the maximum amplitude value of the sampled signal.

Real Power

Real power is the actual power used by the installed load and has units of Joules/sec or Watts. Active power can be calculated using equation 2.

$$P = V \cdot I \cdot \cos \phi \quad (2)$$

P = Real Power

V = Voltage



I = Current
Cos phi = Power Factor

Reactive Power

Reactive power is a power that is not used by the load or power absorbed but is returned to its source and has a VAR (Volt Ampere Reactive) unit. Reactive power can be calculated using equation 3.

$$Q = V \cdot I \cdot \sin \phi \tag{3}$$

Q = Reactive Power (VAR)

V = Voltage (V)

I = Current (A)

Apparent Power

Apparent power is the power obtained from the sum of trigonometry of active and reactive power with the symbol S and has the unit VA. The apparent power can be calculated using equation 4.

$$S = V \cdot I \tag{4}$$

S = Apparent Power (VA)

V = Voltage (V)

I = Current (A)

A relay is driven, or operated, by a relay driver so that it can perform as intended. Figure 3 demonstrates the particulars. Relay Driver Circuit in Figure 1.

Depending on the needs of the circuit, the relay can act as a switch in the circuit to open or close a circuit path. Relays employ electromagnets to move a pair of movable contacts from the open to the closed state. Relays have long been a common device. Relays have specific characteristics that make them more resilient than solid-state devices, despite the fact that solid state switches increasingly replace relays. High current capacity, ESD resistance, and drive circuit isolation are some of these special qualities.

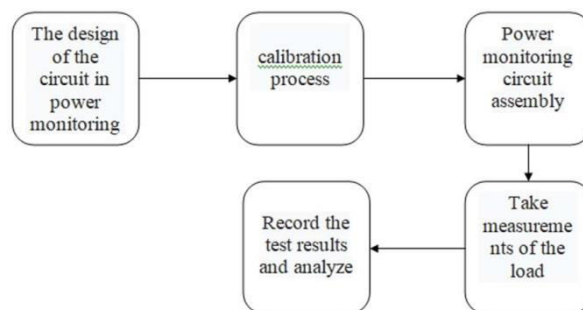


Figure 1. Research Flow

The diagram above shows the outline of the research outline that the author will do in this study. The first step that will be taken by the author is to design a power monitoring circuit so that it will facilitate the writer for the next step. The second step is to validate or calibrate the tool by adjusting the ADC value on the voltage sensor and current sensor so that measurements can be made. The third step is the results of the design, the writer will do a power monitoring circuit assembly. In carrying out this assembly, it will be seen whether the monitoring system is good or not. When it is good, the author will do the test by measuring several loads. After measuring the load, the next step the author will record the results of testing and analysis.

C. Circuit System Monitoring

Figure 2 shows a series of monitoring systems as a whole, there are current sensors, voltage sensors, relays, Nodemcu, LCD, and Arduino which are the components of the monitoring system. The voltage sensor is connected to the analog pin A0 on Arduino, the current sensor is connected to pin A1 on Arduino, the relay is connected Vin and ground, the Nodemcu is connected to the digital pins IO2 and IO3 on Arduino, and the LCD is connected to digital pins SCL and SDA.

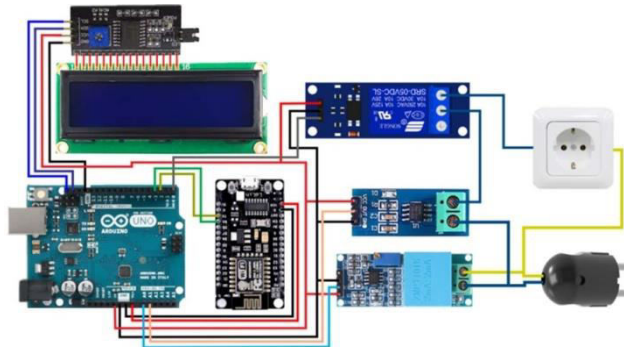


Figure 2. Circuit Diagram

So, a qualified individual should address the wiring system failure as soon as possible. A potential transformer is connected in the circuit, and the primary side receives 230V ac voltage, which is the output from the energy metre, as raw power. Step-down windings on the secondary side of the transformer supply the rectifier section, which consists of four diodes bridged together, with a voltage of 18 volts.

Here, the AC voltage is changed to DC, and the impure DC is then filtered by a 1000 mfd capacitor to provide pure DC voltage. The high voltage protection circuit and regulator 7812 receive the voltage. The complete circuit, including the power supply for the LM324 IC and relay driver units, is powered by the output of the 7812. Via resistors R2, R3, R4, and R5, the LM324 IC's fifth and sixth pins receive the bridge rectifier output voltage, resulting in pin 6 being set to 6.8V with Zener diode D9 attached. The voltage is compared using the op-amp as a comparator, and the output is high or low depending on the input voltage.

In resistor R5, the voltage parameter is adjustable. When the input voltage reaches 260 V, or when there is a high voltage condition, the comparator's output pin 7 drives the transistor Q1 to switch on the relay unit and buzzer. The contactor SW8 is controlled by the relay to cut off the main supply and safeguard home appliances.

The contactor SW8 turns ON/OFF according to the fault that occurred for both neutral leakage and over voltage faults and individual alarm notification through buzzer and led indication is carried out. Red led indication with time delay buzzer sound is enabled for neutral connector faults, and red led indication with continuous beep sound is enabled for excess voltage faults.

D. Testing Prototype

The testing of electrical power monitoring tools is very necessary because to ensure that the system can work well. The testing will be carried out as follows:

1. Voltage Sensor
2. Current Sensor
3. Monitoring display on the LCD
4. Monitoring display on the server
5. Error

Tests on voltage and current sensors are carried out to determine the voltage and current sensors that have worked well and the results of the voltage and current sensor readings by measurements. Furthermore, testing the display monitoring on the LCD and the server is running well or not. Finally, testing the level of system errors when working against measurements.

E. Results data

All data obtained by installing loads to the monitoring device within 2 hours and every 15 minutes will be recorded the reading results. Load selection based on the value of the load power. The results of the reading of electric power monitoring tools are as follows:

1. Refrigerator

The refrigerator used as a load has a power value of 145 W. The value of the power produces readings as follows:

- Voltage = 220 V
- Current = 660 Ma

2. Iron

The iron used as a load is a Philips brand with a power value of 278 W. The value of the power produces readings as follows:

- Voltage = 219 V
- Current = 1268 mA

3. Motor AC 1 Phase

The 1 phase AC motor used as a load is a Bison brand with a power value of 110 W. The value of the power produces readings as follows:

- Voltage = 219 V
- Current = 501 mA

4. Laptop Charger

The Charger Laptop used as a load is a HP brand with a power value of 92 W. The value of the power produces readings as follows:

- Voltage = 219 V
- Current = 422 mA

5. Solder

The solder used as a load is a Dekko brand with a power value of 30 W. The value of the power produces readings as follows:

- Voltage = 219 V
- Current = 132 mA

6. Fan

The fan used as a load is a Philips brand with a power value of 190 W. The value of the power produces readings as follows:

- Voltage = 218 V
- Current = 581 mA

F. Testing Prototype

1. Voltage Sensor

The testing of voltage sensors aims to determine the performance of the voltage sensor is working well or not. The voltage sensor itself will be installed to the Arduino UNO as a medium of readings regulated by the program. The voltage that can enter the Arduino UNO ADC PIN is 5 VDC, so the need for a 220 V PLN voltage is changed to VDC. ZMPT101B voltage sensor has 5 pins, 2 pins are connected to the voltage source and the other 3 pins are connected at 5V, pin A0, and ground.



Figure 3. Voltage sensor testing

Figure 3 shows that the testing of the voltage sensor in the reading and as a monitoring tool. Tool performance testing is done by comparing the measurement of the voltage value with a voltage and voltmeter sensor. The results of the comparison can be seen in Table 1.

Table 1. Voltage sensor testing

Load	Voltage		Error (%)
	Voltage sensor	Voltmeter	
Refrigerator	220 V	220 V	0
Iron	219 V	220 V	0,45
Motor AC 1 phase	219 V	219 V	0
Laptop’s charger	219 V	220 V	0,45
Solder	219 V	220 V	0,45
Dispenser	220 V	220 V	0
Television	220 V	220 V	0
Incandescent Lamps	215 V	217 V	0,9
Fan	218 V	219 V	0,45
Average Error			0,3

Error data obtained from observations in Table 1 by calculating using equation 5 and the average error value obtained from calculations using equation 6.

2. Current Sensor

Figure 4 shows the current sensor testing. Flow sensor testing aims to determine the performance of the sensor in reading the current value works well or not. The ACS712 current sensor retrieves data in a period from several loads installed on the monitoring tool. The ACS712 current sensor generates an analog signal from direct reading, then Arduino is received via the ADC pin. The ACS712 current sensor has 5 pins, 2 pins on this sensor are connected with a voltage source and 3 pins connected with 5V, A1 pins, and ground.



Figure 4. Current sensor testing

This electric power monitoring tool displays the current reading from the load installed on the PLN electricity network. The need for testing the ACS712 current sensor is due to knowing the characteristics of this sensor works by comparing the measurement of the monitoring device with the amperemeter. The loads to be tested are the same as testing the voltage sensor. The results of load testing on the reading of current values can be seen in Table 2.



Table 2. Current sensor testing

Load	Current		Error (%)
	Current sensor	Amparemeter	
Refrigerator	660 mA	662 mA	0,3
Iron	1268 mA	1269 mA	0,07
Motor AC 1 phase	501 mA	500 mA	0,19
Laptop’s charger	422 mA	420 mA	0,47
Solder	132 mA	132 mA	0
Dispenser	158 mA	159 mA	0,63
Television	449 mA	450 mA	0,22
Incandescent Lamps	581 mA	580 mA	0,17
Fan	184 mA	183 mA	0,54
Average Error			0,28

3. Server

This server testing aims to find out the reading of the electric power monitoring tool that is sent to the server has worked well or not. The data from the voltage and current sensor readings will be sent to the server with the help of the NodeMCU module. The server used is Adafruit IO which is one of the libraries of Arduino media to see the results of reading this tool through the internet network.

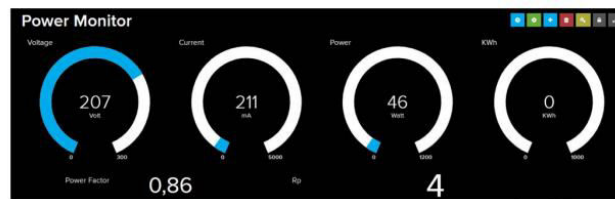


Figure 5. Display on the server

Electricity monitoring system connected to the internet so that users of electricity can monitor remotely. The monitoring system works so that it can be monitored from a distance. First, set the internet network to be used. Currently the author is setting up a monitoring system connected to a mobile hotspot. Second, the monitoring system is turned on and directly connected to the internet network. Third, the monitoring system is connected directly to the load. Then, the monitoring system will read the data at load. The reading will be sent to the server for viewing. Fourth, enter Adafruit IO's server through the available accounts and you can see the results of sending data from the monitoring system.

Figure 5 shows the Adafruit IO server display which shows that there are 6 variables displayed, namely the current value, voltage, power, kWh, power factor and cost. In sending readings from the electric power monitoring device this server takes about 10-15 seconds. The connection of this electrical power monitoring tool to the internet network will allow users of electric energy to be able to see the cost of using electrical energy in each load, even if it is not seen directly from this tool.

The loads tested on this tool are various, namely resistive and inductive loads. Resistive and inductive loads are of course related to the power factor. This power factor will affect the value of the power that will be measured using this monitoring tool. At resistive loads, the power factor is 1 because resistive loads have the same properties as resistors. Whereas in the inductive load, the power factor is not fixed because in the inductive load the flowing current will be induced and turned into a magnetic field so that it will be stored. To be able to measure the value of the power factor at the author's expense using equation 7.

$$\text{Power factor} = \text{Real Power} / \text{Apparent Power} \quad (5)$$

G. Discussion

1. kWh value

This electric power monitoring tool can calculate the kWh value at each load. The purpose of this kWh monitoring is that electrical energy consumers can determine the estimated cost of using the loads attached to the PLN electricity source. The kWh value at different loads can be seen in Graph 1.



Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, India

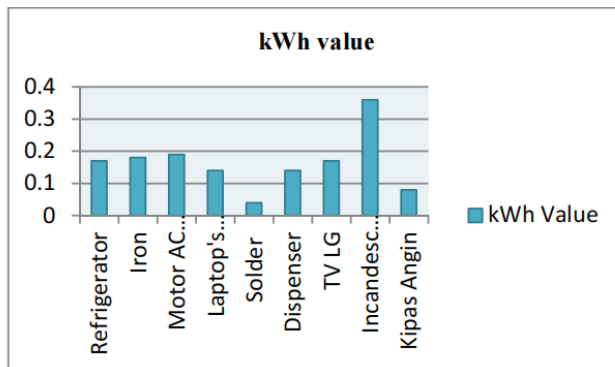


Figure 6. kWh value

Figure 6 shows the loads installed at the PLN power source within 2 hours that have a kWh value monitored from this tool. The monitoring results show that the load has a kWh value of 0.36. The author tests incandescent lamps with several lamps turned on together with a total power of 125 W. When viewed from the results of the data, the load that has the most power is an iron and only has a kWh value of 0.17. This happens because incandescent lamps have many disadvantages namely, only 10% for lighting energy and 90% emitting as heat. Not only that, but incandescent lamps have low efficacy and a short life span of around 1000 hours.

2. Cost Value

This electric power monitoring tool displays the usage costs of the loads connected to the PLN electricity source. The calculation of the electricity consumption cost is done by the kWh value on the load multiplied by the electricity consumption charge rate that has been set by the government per kWh. The cost of using the load can be seen in graph 2.

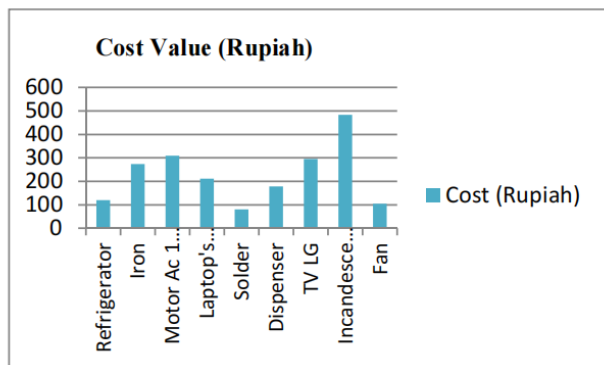


Figure 7. Cost Value

Figure 7 shows that the cost of electricity consumption of the loads, the largest cost is incandescent lamps and the lowest cost is solder. The use of loads that absorb the most electrical energy will produce a large kWh value too, and cause consumption costs to follow the large and small kWh values. Therefore, energy savings must be done by minimizing the use of electrical energy by using electricity as needed.

This electric power monitoring tool can display from the reading of the voltage and current values. The voltage and current values are calculated into kWh values and electricity consumption costs, in addition to this monitoring device, there is a relay as a switch that can limit the incoming current so that users of electrical energy can save electrical energy by regulating the value of the load current that can be used.

The rise and fall of PLN source voltage also affect the stability of this tool in calculating the cost of electricity consumption. This will cause an error in the voltage and current sensor in reading the voltage and current value data at the load.



V. CONCLUSION

With the use of this equipment, regular people may quickly determine whether their home is electricity overload-free. If there is any power overload, the gadget notifies the user visually and loudly and isolates the loads. It makes the consumer aware that the error can be fixed with a technical person's assistance. The tool also makes it simple for the technical expert to locate the over/faulty loads. It aids consumers in keeping each home's electrical system in good condition and save the power consumption.

Customers can save money and pay actual energy consumption costs. With the aid of our equipment and the digital energy metres, the consumer will be delighted with precise and accurate energy measurement.

The customer is aware that the bill is appropriate given their consumption. Thus, the aforementioned device is used to resolve billing-related issues between the customer and the supplier.

Using our gadget automatically lowers billing-related complaints to an acceptable level. As a result, the supply provider can use the opportunity to better address the issues of other customers. It prevents power consumption loss caused by overload/overcurrent of the loads. The money saved is put towards a variety of other beneficial Supply Company development initiatives. Here, the consumer and the supplier can establish a solid working connection. While it is a tiny item, it aids in the resolution of larger issues.

REFERENCES

- [1] Patricia Franco, Jose Manuel Martinez, Young-Chon Kim and Mohamed A. Ahmed (2021), "IOT Based Approach for Load Monitoring and Activity Recognition in Smart Homes". 10.1109/ACCESS.2021.3067029.
- [2] Husein Mubarak & Agus Ardiansyah "Prototype Design of IoT (Internet of Things)-based Load Monitoring System", 2020 3rd International Seminar on Research of Information Technology and Intelligent Systems (ISRITI).
- [3] Gautam A. Raiker, Subba Reddy B., L. Umanand, Shubham Agrawal, Anchal S. Thakur, Ashwin K., John P. Barton†, Murray Thomson†, "Internet of Things based Demand Side Energy Management System using Non-Intrusive Load Monitoring", 2020 IEEE International Conference on Power Electronics, Smart Grid and Renewable Energy (PESGRE2020).
- [4] 1st Qidong Fan School of Navigation'Wuhan Univesity of Technology Wuhan Univesity of Technology Wuhan,China, "Overload Monitoring System for Inland River Ferries", The 5th International Conference on Transportation Information and Safety, July14 – July 17, 2019, Liverpool, UK.
- [5] Goran Horvat, Davor Vinko and Drago Zagar 2013, "Household Power Outlet Overload Protection and Monitoring using Cost Effective Embedded Solution", MECD - 2013 Budva, Montenegro.
- [6] DoruVatau; PetruAndea; Flaviu Mihai Frigura-Iliasa, Overvoltage protection systems for low voltage and domestic electric consumers, 15th IEEE Mediterranean Electro technical Conference (2010), Melecon.
- [7] W.C.Turner Steve Doty Energy Management Handbook (John Wiley and Sons) 2009.



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details