

POWER MATE

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ABSTRACT

In our life there are many economic challenges facing a customer because the cost of electricity is very high nowadays. The high electricity bill because of the customer cannot control the power consumption. We are looking for a unique solution that is easy to use, also having small size. In our project we try to make a smart device that can help the customer to control the power consumption and help the electricity company to contact with a meter remotely.

Keywords- Power Mate, Power Consumption, Meter, GLCD, Arduino, GSM.

1 INTRODUCTION

These days, people are increasingly relying on electronic applications, it makes the work and life easier, and it also saves time and effort. People use it in their homes refrigerators, washing machines and televisions, now the technology looks forward to remote control.

Power consumption is growing daily due to the increase in number of electronic devices, which leads to increase their monthly electricity bill which raises the cost of kilowatt consumption based on the packages determined by the electricity company. Our goal is to have a device that allows the user to control remotely (via SMS) the electricity meter and know and manage the power consumption which helps the users to reduce the bill

Also it can help the electricity company to control the meter remotely this can reduce time and cost of man power (Power meter reader). Power-Mate provides the company with the power consumption at any time; also it can cut off the current if the user did not pay the bill. Also the meter sends to its user a message to warn about the current packet has reached its limit.

In Jordan, one of the issues the electricity company faces is that power consumption during day light is very high forcing the company to use extra power generators which lead to higher cost. One of this device's functions is to allow the company to control the power consumption of the country to approximately be an average at all times by informing the customer via SMS that using electric devices such as dishwashers, washing machines etc. at night may help save energy and cost to both customers and the company.

Another function the Power Meter provides is the ability to reduce the current provided to the customer. The electricity company can use this technique to warn the customer if he/she hasn't paid the electricity bill and the power is about to be cut off. This way the company can allow their customers to use only a limited amount of electricity devices in their homes such as lights and the refrigerator for example.

2 SYSTEM MODEL

Basically this project consists of Arduino, graphical LCD, GSM module, meter, IR connector and Keypad.

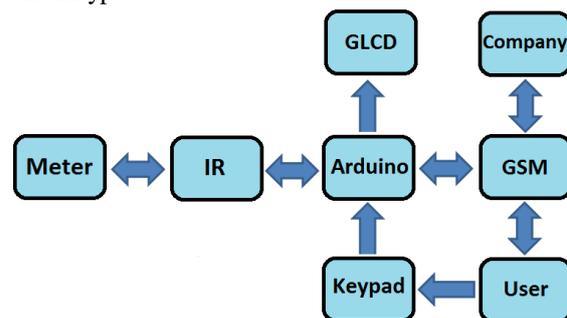


Figure 1: The System Block Diagram

As shown in Fig. 1. Our project process works in a full duplex way. Basically each end of the month the Arduino sends a command to the power meter through the IR connection and then the meter responds to the Arduino with the power consumption (in kilowatt) through the IR connection. The Arduino's job here is to receive the data and calculate the bill to be sent to the user and the electricity company.

One of the options available to the user is to see how much power is consumed for the current month then an SMS command is to be sent from their mobile to the Arduino via GSM, where the Arduino calculates the bill up till the meaning time and replies with the amount of kilowatts and cost. A GLCD and keypad were added to the design in case the user wanted to interact directly with the device.

3 HARDWARE DESIGN

Now for the hardware design of our project, the main component that handles most of the processing is the Arduino. First, data has to be taken from the meter, therefore we designed an IR cable consisting of a transmitter and a receiver connected to the Arduino. Users can use a keypad connected to the device to enter data directly. As an input and output the GSM is added to communicate remotely with users, it is used to receive commands and send data. Another output interface used in our system is the GLCD attached to the Arduino which displays information and settings. All these components together are connected to the Arduino which manages and operates to give us the Power Mate. THE FOLLOWING FIGURE SHOWS THE IR CABLE HOW IT IS CONNECTED TO THE ARDUINO.

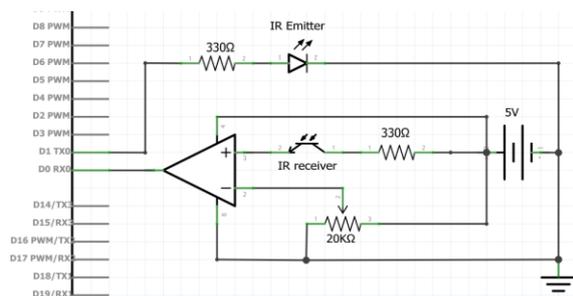


Figure 2: Arduino interfaced with the IR Tx/Rx

The GSM is connected to the Arduino as a Shield that is designed to fit exactly above the Arduino and its pins are connected as shown below.

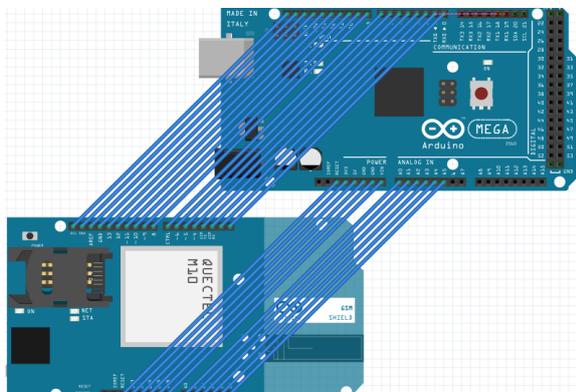


Figure 3: Arduino with GSM Shield

As for the Graphical LCD, it's connected to the digital pins of the Arduino with a potentiometer as

we can see below.

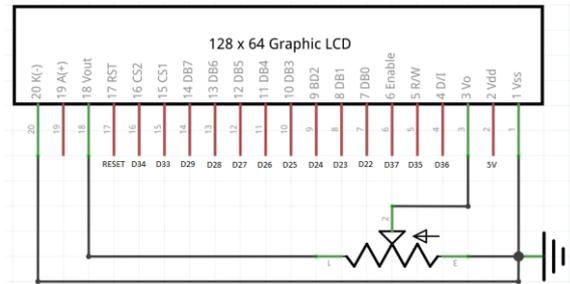


Figure 4: Arduino interfaced with the Graphical LCD

The Keypad was added to use the device directly and was connected as shown below.

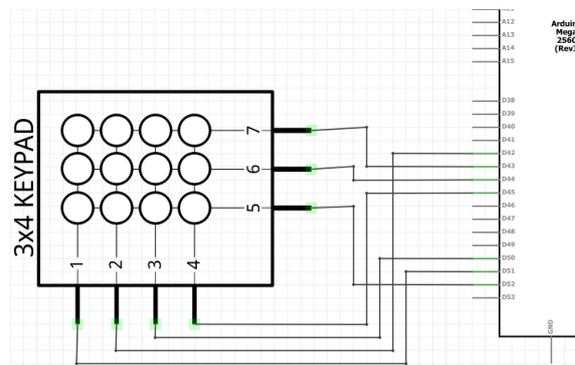


Figure 5: Arduino interfaced with the Keypad

4 SOFTWARE DESIGN

After having the hardware ready, the software part begins where data is being manipulated and organized to be sent to users. First of all, the Arduino in idle state waits for a request to be given via GSM or the keypad, after that the Arduino sends the command to the meter via the IR connection to give us the information it has, which allows the Arduino to save this data by storing it into an array or string and process it by looking for the required information requested by the user and sending it back through the GSM or displaying it on the GLCD. The Arduino commands the meter to send the data it has by sending a slash, question mark, exclamation mark ("/?!"). Each time a request has been received, the Arduino has to take fresh data from the meter in order for the information to be updated. Now for the data the Arduino receives, it looks for how many Kilowatts were consumed for a specific month and calculates the bill with the company's prices for each packet. Another function the Arduino provides is that it warns the user each time he/she has exceeded a packet limit and the price of electricity is now higher. On the other hand, the device can contain two cell phone numbers of users in order to communicate with. The numbers stored can be edited by the keypad or through an SMS command but with safety and confirmation protocol similar to changing a

password to an email address. For the keypad to be used, a password is needed for the safety of the device from fraud or abuse.

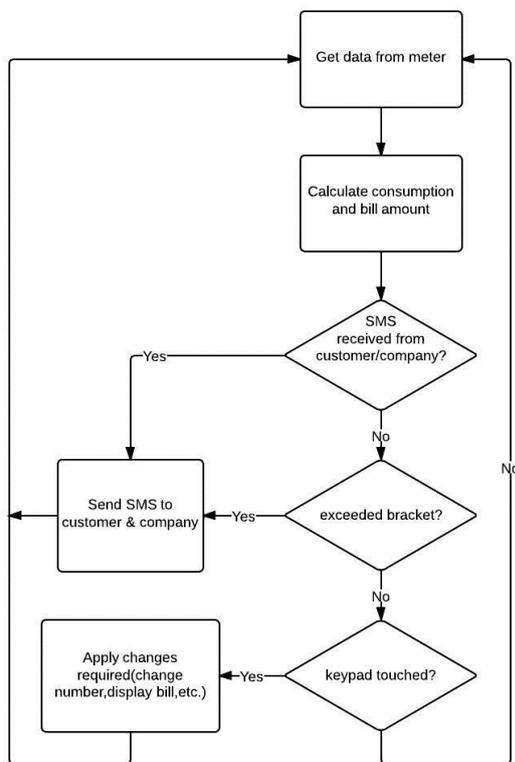


Figure 6: General Flow Chart

5 PROBLEMS

As for the problems we have faced, the IR connection we used consisted of an infrared transmitter and an infrared receiver with current limiting resistors connected to the Arduino. When the Arduino sends its command to the meter, the meter responds but the Arduino detected nothing but noise on its receiver. After analyzing the problem by using a digital oscilloscope and examining the signals sent and received, we added an amplifier to raise the threshold voltage on the receiving part of the Arduino to give us discrete data with no noise at all. Another problem we faced was that the Arduino's transmitter and receiver always used to send and receive incorrect data. By using the oscilloscope we found out that both the Arduino's transmitter and receiver were inverted, resulting in sending and receiving incorrect inverted data. The solution was adding a CMOS inverter to both the transmitter and receiver of the Arduino which gave us correct results when interfaced with the meter.

6 RESULTS

In this project, we were able to design a helpful device that would advance electric meters in Jordan to a much higher level that helps both the customer and the electric company. This project allows the customer to stay notified about his electricity bill in order to manage power consumption to save money. The electric company on the other hand can save time by controlling its electric meters remotely and observe its readings from distance.

7 CONCLUSION

In conclusion, this device was designed in order to help the customer control and observe his power consumption.

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