B.Sc. in Computer Science and Engineering Thesis

Automated Electricity Billing System for Bangladesh

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CERTIFICATION

This thesis paper titled **"Automated Electricity Billing System for Bangladesh"** is submitted by the group as mentioned below has been accepted as satisfactory in partial fulfillment of the requirements for the degree B.Sc. in Computer Science and Engineering on December 2013.

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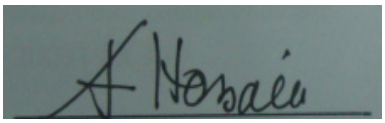

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CANDIDATES' DECLARATION

This is to certify that the work presented in this thesis paper is the outcome of the investigation and innovation carried out by the following students under the supervision of Md. Azmal Hossain,Faculty of MIST & Graduate Student, Department of CSIT, SCSU, St. Cloud, MN, USA.It is also declared that neither of this thesis paper nor any part thereof has been submitted anywhere else for the award of any degree, diploma or other qualifications.

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ABSTRACT

There are mainly three utility services available in Bangladesh. They are Electricity, Natural Gas and Water. The procedures of these services are mainly manual. We tried to give an automated solution for these utility services, starting from applying for the service to the billing system along with all other facilities required. We mainly focused on electricity utility service for the proposed solution. But this solution can be equally applicable to any other utility services with certain modification. Since the bill payment can be done through online banking and application for new connection can be done online, we emphasized on meter reading and its processing to generate bill. We proposed a GSM based meter reading service and tried to make a prototype with present electric meter available in Bangladesh. We believe this solution can upgrade the utility service of Bangladesh. It will be helpful to monitor the usage of the services, to control the services remotely, to stop corruption in this sector and also to make efficient consumption of valuable energy of Bangladesh.

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LIST OF ABBREVIATION

AMR : Automatic Meter Reading System

GSM : Global System for Mobile Communications

PLC : Power Line Communication

DESCO : Dhaka Electric Supply Company Limited

DPDC : Dhaka Power Distribution Company Limited

REB : Rural Electrification Board

CHAPTER 1

INTRODUCTION

1.1 Overview

With the development of technology now a days the automation in every field is becoming necessary. But in Bangladesh automation is not applied in the field of utility bills collection. In the present system the service provider for energy still uses conventional methods for getting the energy consumed by individual customer. The meter reader people goes to each meter and takes the meter reading manually to issue the bills which is prepared by the electricity Board station after submitting the meter data. This energy meter reading is a monotonous and an expensive task. Also the data can be erroneous. So we proposed here a "GSM based Automatic Meter Reading (AMR) System"which automatically collects the meter reading and sends it to the service provider using short message services(SMS). It uses GSM modems for this purpose. After processing the bills, it sends to the respective individual customer via a SMS. This system allows the customers to pay bill online either by credit card, debit card or by online banking.It also provides the facility to disconnect the supply of a customer by the service providers remotely.Customers can re-connect the power after the deposition of dues.We analyzed various AMR systems existing all over the world and found they are not feasible for Bangladesh. Our proposed system is appropriate for Bangladesh perspective.It provides low cost, high performance, highest data rate, highest coverage area which it feasible for our country. So this "GSM based AMR system"is more efficient than convention billing system.

Electricity is the driving force behind the development of any country. With the rapid increase in residential, commercial, and industrial consumers of electricity throughout the world, it has now become imperative for utilities companies to devise better, non-intrusive, environmentally-safe techniques of gauging utilities consumption so that correct bills can

be generated and invoiced.

In Bangladesh, the electricity billing system is completely manual.The electricity meters are installed on consumers'premises and the consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises. Sometimes the consumers give some extra money to the meter reader for less meter reading. As a result corruptions occur and actual payment is not received by the service provider. So the provider faces a huge amount of loss in every year. Besides it not only wastes human labor, but also creates man-made meter error. Sometimes the meters are installed inside people's homes and if there is nobody at home and meter readings are even more difficult. To overcome these disadvantages of the traditional meter reading system, it's very necessary to implement AMR in Bangladesh to provide comprehensive information to the consumer and service providers for efficient use of the utilities.

1.2 AMR (Automated Meter Reading System)

Automatic meter reading, or AMR, is the technology of automatically collecting consumption, diagnostic, and status data from water meter or energy metering devices (gas, electric) and transferring that data to a central database for billing, troubleshooting, and analyzing.This technology mainly saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is that billing can be based on near real-time consumption rather than on estimates based on past or predicted consumption. This timely information coupled with analysis can help both utility providers and customers to better control the use and production of electric energy, gas usage, or water consumption. AMR include various technology for data collection such as power line communication,Zigbee, Radio Frequency (RF Method) and GSM network but GSM network is best among this technology. So here we proposed a GSM based AMR system[5].

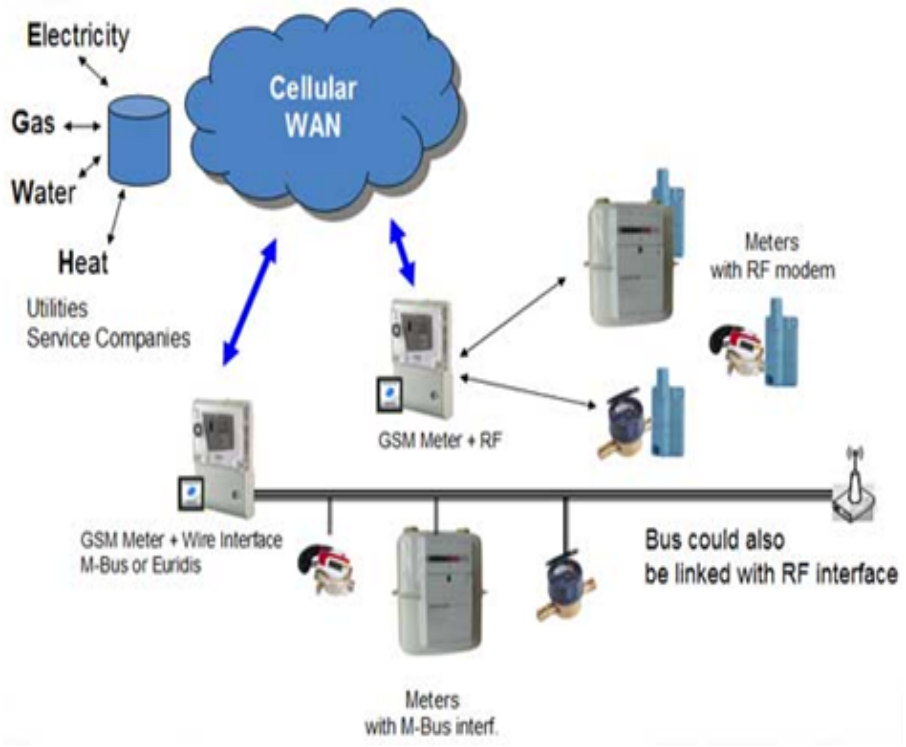

Figure 1.1: Different AMR systems used in a network

1.3 Proposed System

In our proposed GSM based AMR system there are four basic units. They are reading unit, communication unit, data receiving and processing unit with billing system.

1.3.1 Reading Unit

Most of the customer still uses digital meter for utility consumption,so we are not proposing any new meter. We want to connect a miniature GSM module with the conventional meter which will take reading from meter and then convert this data into digital data ready for transmitting. This module also consist a SIM (Subscriber Identity Module) card which is responsible for transmission of data to the provider end.

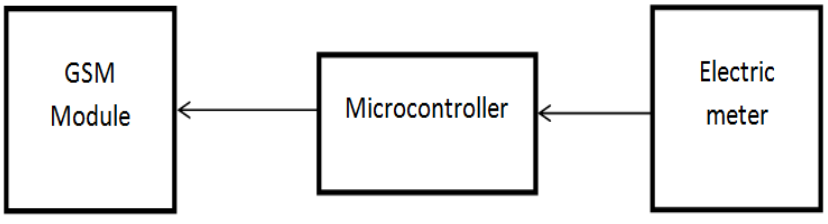

Figure 1.2: Block Diagram of Reading Unit

1.3.2 Communication Unit

In the communication unit GSM network is used between meter end and the server end because of its wide coverage area,well established Network, low Set up cost less than Network based AMR.

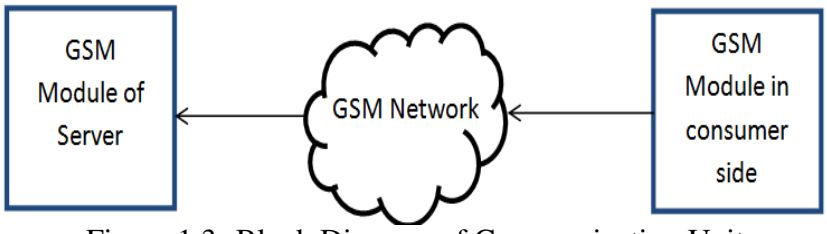

Figure 1.3: Block Diagram of Communication Unit

1.3.3 Receiving Unit

At the provider end there will be a GSM modem which is responsible for data receiving. And this modem is connected to the computer which is responsible for data processing.

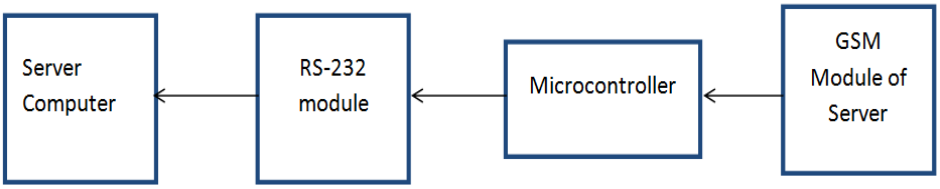

Figure 1.4: Block Diagram of Receiving Unit

1.3.4 Processing Unit

There will be a computer server at the service provider end which will calculate the data received by the receiving unit and will generate bill for energy consumption. Then the total bill will be sent to the consumer.

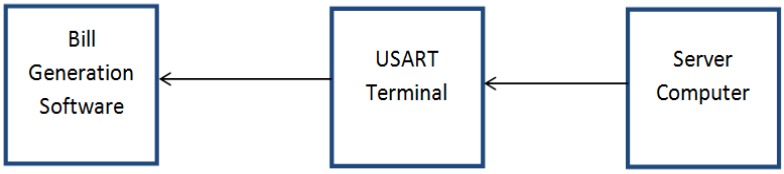

Figure 1.5: Block Diagram of Process Unit

1.4 Objectives

We introduce here a GSM based AMR system which is more appropriate for Bangladesh than other existing techniques.Our main objectives are:

1. To reduce data collection costs,

2. To improve meter reading accuracy,

3. To enable faster, more efficient reading system and billing process,

4. To provide highest coverage area

5. Significantly increase operational efficiency by providing real time pricing and monitoring of energy consumption,

6. To improve customer service.

7. To provide a full solution for the energy sector to reduce energy consumption and corruption in this sector.

CHAPTER 2

AVAILABLE TECHNOLOGIES FOR AMR AND ITS IMPLICATION IN BANGLADESH

2.1 Overview

Automation is applied in almost every field. There are several automated meter reading technologies available for utility bills collection around the globe. We discuss some of them here.

2.1.1 Touch Technology

With touch based AMR, a meter reader carries a handheld computer or data collection device with a wand or probe. The device automatically collects the readings from a meter by touching or placing the read probe in close proximity to a reading coil enclosed in the touchpad. When a button is pressed, the probe sends an interrogate signal to the touch module to collect the meter reading. The software in the device matches the serial number to one in the route database, and saves the meter reading for later download to a billing or data collection computer. Since the meter reader still has to go to the site of the meter (sometimes referred to as "on-site"AMR), this technology requires a high labor cost[5].

Figure 2.1: Touch technology based AMR

2.1.2 RF-Based Meter Reading

Billing and customer service functions are reliant on the accuracy of meter reading data. To avoid the inaccurate data because of meter reading errors, the RF-based meter reading technology is developed.

Radio frequency based AMR can take many forms. The more common ones are handheld, mobile, satellite and fixed network solutions. There are both two-way RF systems and one-way RF systems in use that use both licensed and unlicensed RF bands[5].

In a two-way or “wake up”system, a radio transceiver normally sends a signal to a particular transmitter serial number, telling it to wake up from a resting state and transmit its data. The meter attached transceiver and the reading transceiver both send and receive radio signals and data. In a one-way “bubble-up”or continuous broadcast type system, the transmitter broadcasts readings continuously every few seconds. This means the reading device can be a receiver only, and the meter AMR device a transmitter only. Data travel one way, from the meter AMR transmitter to the meter reading receiver. There are also hybrid systems that combine one-way and two-way technologies, using one-way communication for reading and two-way communication for programming functions[5].

RF-based meter reading usually eliminates the need for the meter reader to enter the property or home, or to locate and open an underground meter pit. The utility saves money by increased speed of reading, has lower liability from entering private property, and has less chance of missing reads because of being locked out from meter access.

The technology based on RF is not readily accepted everywhere because of its small coverage area, the consumers can be facilitated with to low-power RF facility.

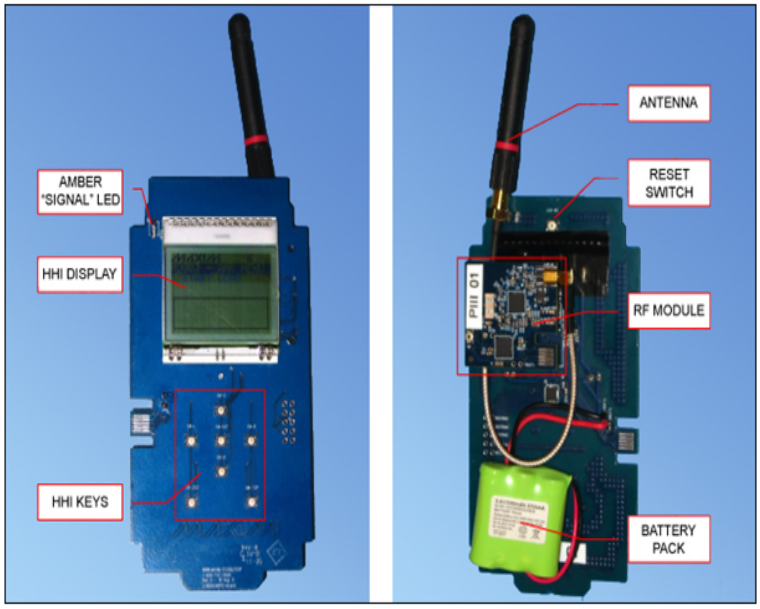

Figure 2.2: RF based AMR

2.1.3 PLC Based AMR

Power line communication is very popular in AMR field. It provides timely and reliable monitoring and acquisition of utilities meter readings at consumer premises from remote. The solution can be used for electricity, water and gas meters.

AMR is a method where electronic data is transmitted over power lines back to the substation, then relayed to a central computer in the utility's main office. This would be considered a type of fixed network system the network being the distribution network which the utility has built and maintains to deliver electric power.

The solution uses the existing 230V / 110V AC power transmission wires thus requires no extra wiring. This eliminates the issue of concrete walls, slabs or other type of obstacles a big hurdle for wireless solutions. The range increases to hundreds of meters with obstacles. The use of repeaters can increase the range to kilometers[6].

The concentrator module collects data from every meter reader (node) using PLC. It then transfers the data to central website over GPRS connectivity. The website in turn feeds the data to service providers billing servers thus creating a totally automated and reliable

measurement and billing infrastructure[6].

Value added services include alerts for prepaid users, SMS facility to switch off gas supply, alerts on gas leak detection and automatic switching off gas supply, credit card payment facility, etc[6].

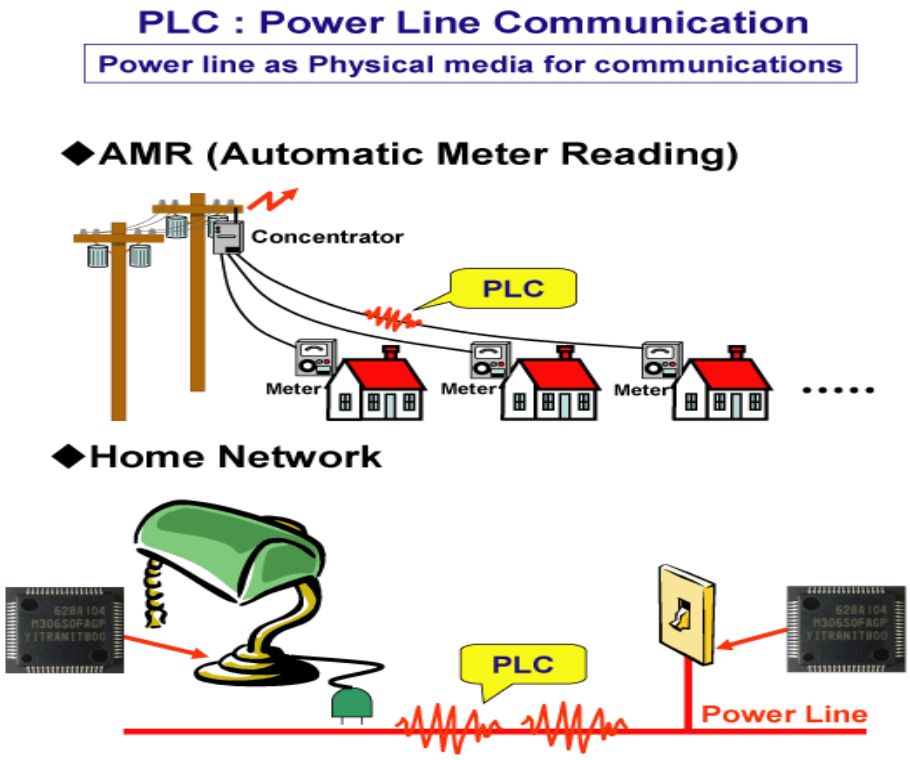

Figure 2.3: PLC based AMR[1]

2.1.4 Automatic Meter Reading System Using Zigbee

Some manufacturers are developing mesh networks where meters themselves act as repeaters passing the data to nearby meters until it makes it to a main collector. The Swedish city of Gothenburg is having their electric meters connected in this manner, using the ZigBee protocol. A mesh network may save the infrastructure of many collection points, but is more data intensive on the meters.

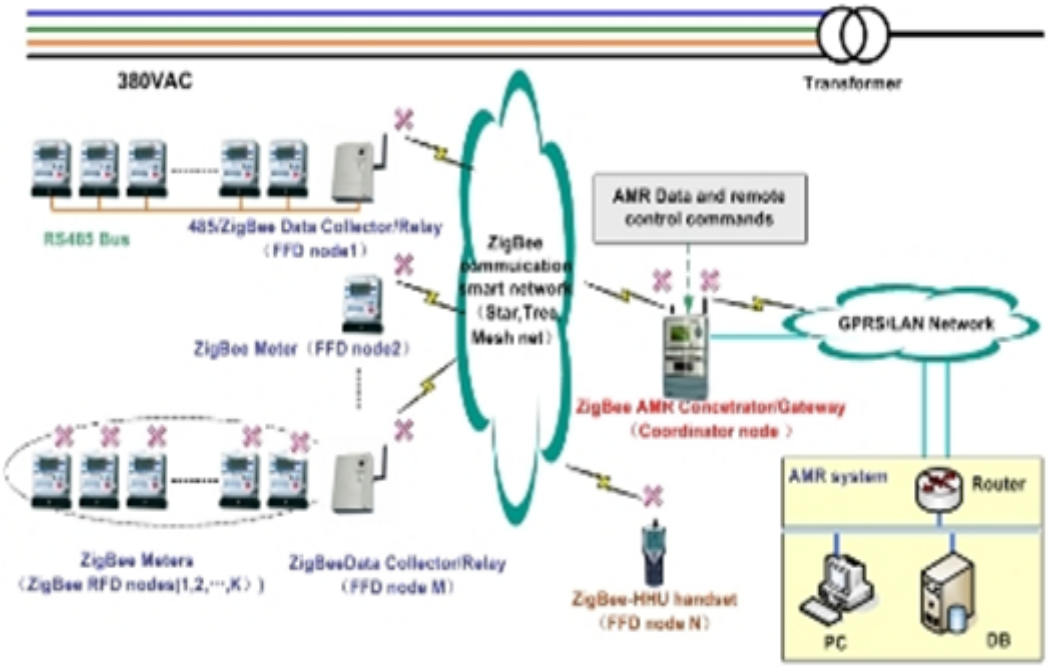

Figure 2.4: Zigbee based AMR[2]

2.1.5 Automatic meter reading system using Wi-Fi

Automated Meter reading is implemented in some countries through Wi-Fi network. But it requires an established Wi-Fi network. The set up cost is comparatively high.

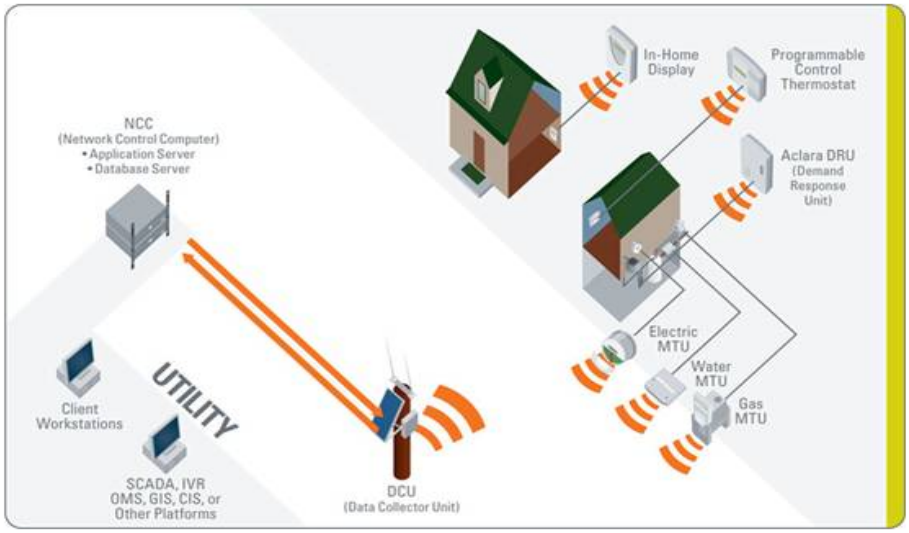

Figure 2.5: Zigbee based AMR

2.1.6 Automatic Meter Reading System Using Bluetooth

Bluetooth is radio wave communication that uses the 2.4 GHz band and can be used in Common globally, this is rare. Bluetooth specifies a profile for applicable equipment, enabling device-to-device and equipment-to-equipment connection. But it has a very short range and Bluetooth enable mobile is required.

Figure 2.6: Bluetooth based AMR[3]

2.1.7 Automatic Meter Reading System Using GSM

In GSM based automated meters GSM modem and GSM network is used to send data from meter to the service provider. It communicates through text messaging. It is wireless data communication; it provides service provider facility to monitor real time user performance.

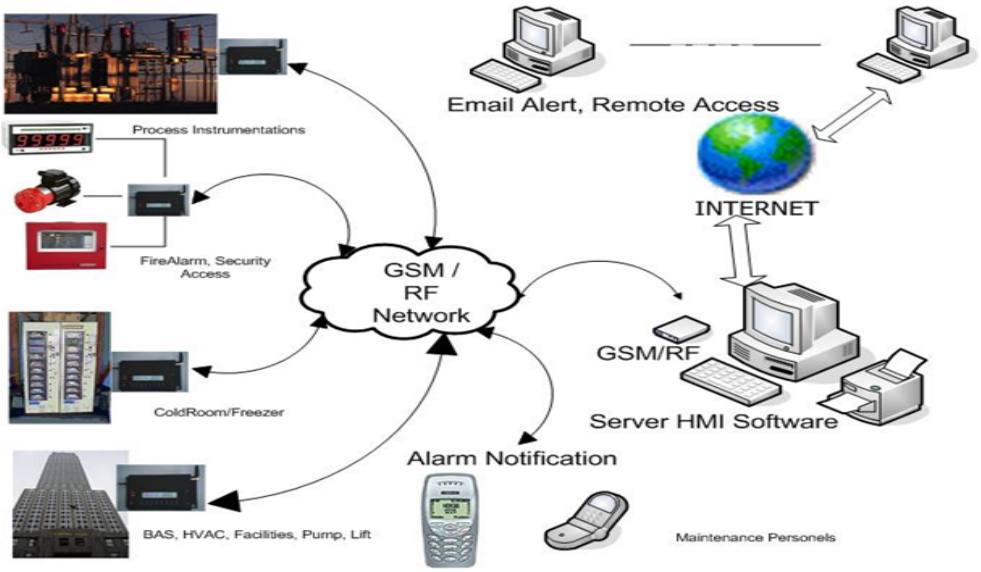

Figure 2.7: GSM based AMR

2.2 Existing Systems for Electricity Bills in Bangladesh

In Bangladesh the electricity bills collection process is not automated. Instead it is completely manual called handheld system. There are several power distribution companies who are engaged to provide electricity to all parts of Bangladesh. Such as DESCO (Dhaka Electric Supply Company Limited), DPDC (Dhaka Power Distribution Company Limited) and REB (Rural Electrification Board).Where DESCO is responsible for providing power to certain parts of area like mirpur,gulshan etc. On the other hand, DPDC supply electricity to the consumers of Dhaka city corporation area and REB is engaged to provide electricity to the rural area of our country. Now we will discuss about each of their electricity supply process, utility bills collection, bills distribution process and bill payment process and also analyze their performance.

2.2.1 BPDB(Bangladesh Power Development Board)

Bangladesh Power Development Board (BPDB) is a statutory body created in May 1, 1972, by presidential Order No. 59 after bifurcation of erstwhile Bangladesh Water and Power Development Authority. BPDB started its operation with Installed Generation capacity of only 200 MW. Installed Generation capacity (November 2013) has increased to 10213 MW.

As part of reform and restructuring a number of Generation and Distribution companies have been created. The subsidiaries of BPDB are:

- Ashuganj Power Station Company Ltd. (APSCL)

- Electricity Generation Company of Bangladesh (EGCB)

- North West Power Generation Company Ltd. (NWPGCL)

- West Zone Power Distribution Company Ltd. (WZPDCL) The BPDB is responsible for major portion of generation and distribution of electricity mainly in urban areas except Dhaka and West Zone of the country. The Board is under the Power Division of the Ministry of power, Energy and Mineral Resources, Government of Bangladesh. BPDB has taken a

massive capacity expansion plan to add about 10500 MW Generation capacity in next 5 years to achieve 24000 MW Capacity according to PSMP-2010 by 2021 with the aim to provide quality and reliable electricity to all the people of Country for desired economic and social development. The power system has been expanded to keep pace with the fast growing demand[4].

Generation Planning:

Generation Planning is the most important part of the power system and the reliability of the whole power system depends largely on the reliability of power generating system. The generation in the system should be such that it can supply the demand at all times under the outage of normal maintenance and forced outage. To develop generation addition sequence Power System Master Plan of 2010 used PC-based WASP (Weign Automatic System Planning Package) and PDPAT software. This software determines least-cost generation addition sequences based upon the load characteristics, schedule maintenance, forced outage, and reliability level plant cost etc. The least cost generation addition sequence includes peak and base load plants of optimum unit size. Since then BPDB has been using PC-based WASP for generation planning. Annual LOLP (LOSS-OF LOAD PROBABILITY) of 2% is being used as reliability criteria. The equivalent to about 8 days/year of LOLE (LOSS-OF-LOAD-EXPECTATION). Indigenous natural gas, coal, nuclear, cross-border trade and hydro resources are mainly considered for generation planning as fuel. In case of generation plant sitting regional balance in generation is being given due importance. Other factors such as availability of fuel, cooling water, transportation of heavy equipment, proximately to grid network load center etc. are also considered for plant sitting[4].

Distribution Zones:

BPDB is responsible for distribution of electricity in most of urban areas in Bangladesh except Dhaka Metropolitan City and its adjoining areas under DESA and DESCO, areas under West Zone Power Distribution Company Limited (WZPDCL) and some of the rural areas under Rural Electrification Board (REB)[4].

At present only 42.09% of the population is served with electricity and per capita electricity consumption is only 169.92 Kwh (FY -2006). Presently BPDB's distribution network is comprising of 33 KV, 11 kV and 11/0.4 KV lines.Total distribution line in the country is about 2,09,932 km of which 46,599 km belongs to BPDB and total number of consumer of

different category is about 15,18,891 at the end of FY 2006[4]. Followings of the Distribution Zones of BPDB:

* Chittagong

* Comilla

* Sylhet

* Mymenshing

* Rajshahi

* Rangpur

Tariff rate:

CATEGORY - A : RESIDENTIAL LIGHT POWER

Applicable to the electricity service through a single watt hour meter for lighting and appliances used in a dwelling place including related grounds and buildings, having sanctioned load up to 50 KW.

CATEGORY - B : AGRICULTURAL PUMPING

Applicable to the electricity service through a single watt hour meter for irrigation and drainage of the land for the purpose of cultivation, having sanctioned load up to 50 KW.

CATEGORY - C : SMALL INDUSTRIAL

Category-C is applicable to the electricity service through a single watt hour meter for small industry, where articles or substances are produced, adopted, manufactured, altered, repaired, ornamented, finished, packaged or treated from raw materials with a view to their use, sale, transport, delivery and disposal having a sanctioned load up to 50 KW.

CATEGORY - D : NON-RESIDENTIAL LIGHT POWER

Applicable to the electricity service through a single watt hour meter for hospitals, educational institutions, religious charitable establishments and all classes of consumers other than those specified under category A, B, C, E J having sanctioned load up to 50 KW.

CATEGORY - E : LT COMMERCIAL

Applicable to the electricity service through a single watt hour meter for offices, trading and commercial enterprises such as shops, businesses, hotels cinema halls, having sanctioned load up to 50 KW.

RATE : CATEGORY - F : MEDIUM VOLTAGE GENERAL PURPOSE (11 KV)

Applicable to the electricity service through energy and demand meters for all classes consumers having sanctioned load up to 5 MW, where the consumer provides his own substation, including transformer, high tension control, protection and power factor correction equipment.

CATEGORY - G-1 : EXTRA HIGH VOLTAGE DESA (132 KV)

Applicable to the electricity service through energy and demand meter for Dhaka Electric Supply Authority (DESA) receiving power at 132 KV.

CATEGORY - G-2 : EXTRA HIGH VOLTAGE GENERAL (132 KV)

Applicable to the electricity service through energy and demand meter for all classes of consumer receiving power at 132 KV having sanctioned load above 15 MW upto150 MW, where the consumer provides his own sub-station including transformer, high tension control, protective and power factor correction equipment.

CATEGORY - H : HIGH VOLTAGE GENERAL PURPOSE (33 KV)

Applicable to the electricity service through energy and demand meter for all classes of consumers other than REB/PBS receiving power at 33 KV, having contracted load up to 15 MW other than REB/PBS where the consumer provides his own sub-station, including transformer and high tension control, protective and power factor correction equipment.

In absence of maximum demand meter the maximum demand of the consumers categories G2 H may be calculated as follows :

100% for the first 75 KW of Connected Load

85% for the next 75 KW of Connected Load

75% for the next 75 KW of Connected Load

65% for the next 75 KW of Connected Load

60% for the rest

CATEGORY - I : HIGH VOLTAGE BULK SUPPLY FOR RURAL ELECTRIFICATION OF BOARD/ PALLI BIDDYUT SAMITI

Applicable to the electricity service through energy and demand meter for REB/PBS receiving power at 33 KV, having contracted load up to 15 MW, where the consumer provides his own transformer, high tension control, protective and power factor correction equipment.

CATEGORY - J : STREET LIGHT AND WATER PUMPS

Applicable to the electricity service through a single watt-hour meter for Municipality, WASA and Public Health for the purpose of street lighting and drinking water pumping stations having sanctioned load up to 50 KW.

Bills Distribution Process And Payment Option:

The procedure to distribute electricity bills among the consumers and their bill payment process are shown by the block diagram.

After paying the bills the consumer gets notification through SMS[4].

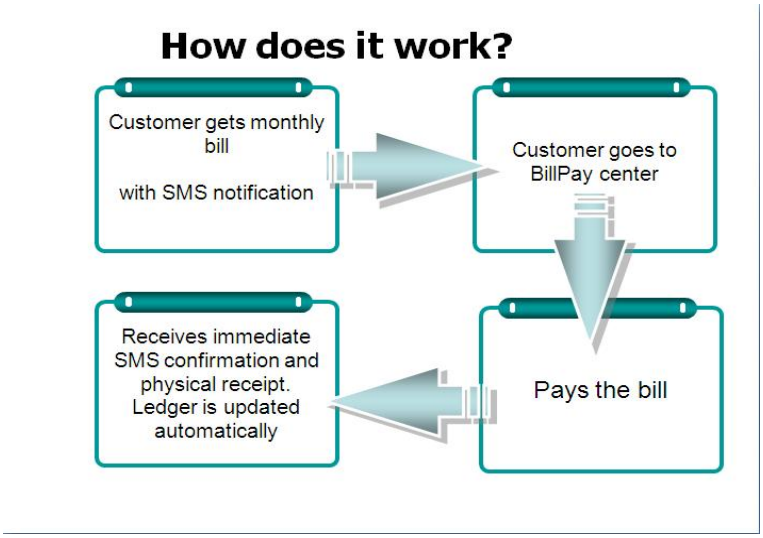

Figure 2.8: Bill Distribution And Payment process[4]

2.2.2 DESCO (Dhaka Electric Supply Company Limited)

Dhaka Electric Supply Company is one of the most leading power supply company in Bangladesh. Mirpur, Pallabi, Kafrul, Gulshan, Banani, Uttara, kallanpur, Cantonment, Uttorkhan , Dakkhinkhan, Badda , Tongi , Baridharaetc total 220 square kilometers area of Dhaka city is considered under DESCO[7].

Establishing New Connection:

There are several steps for establishing a new connection. At first the application form for establishing a new power supply connection is collected from “One Stop Service”. After filling up the application form properly the applicant need to pay the application fee to the respective bank and submit the application form to the local office. Then a person from the local office goes to the applicants premises to check the feasibility of the connection. If the feasibility test is positive then the consumer need to pay the establishment cost. An electric meter is provided from the service provider and a new power supply connection is established. The first month billing of the consumer will be started according to the billing cycle of next month.

Application form fees are as follows:

* For establishing Single phase (2-wire) 230volts and three phase (4-wire) connection- application form cost-BDT 150 and for each meter the cost will be- BDT 15.

* For three phase (3-wire) 11000volts the application forms cost-BDT 250.

* For Temporary (2-wire) 230volts and (4-wire) 400volts-connection cost- BDT 250 [7].

Utility Bills Collection Process:

Meter Readers collect the meter reading as per Schedule. They go from door to door of Consumers premises once in a month according to Schedule Date. They write Meter Reading in a Meter Card that is preserved in Consumer end. They also write Meter Reading in a Meter Book that is preserved in DESCO Office. Electricity Bill is prepared as per this Meter Reading[7]. Meter Reading Schedules are as follows:

1. L T (Low Tension) Consumer: Normally from 05th to 25th of each month.

2. LTI (Low Tension Industry) Consumer: Normally from 26th (current month) to 05th (next month).

3. HT (High Tension) Consumer: Normally from 28th (current month) to 03th (next month)[3].

Bills Calculation Process:

Billing period is considered as the period in which consumers are charged for using the energy.Meter readingis hold from the difference of consumed energy by the consumer between the previous and latest reading (measured in kilowatt hours or KWh). The customer is charged for using each KWh of electricity by the supplier authority. If a customer pay a standing charge (which covers things like meter readings and the cost of keeping connected to the network) hell pay a single rate; otherwise he will pay a higher price for a given number of units and then a lower rate thereafter. A unique number is given for each meter. If the meter is changed during billing period, readings of two different meter numbers can be seen[7].

Tariff Rate:

New tariff rates with respect to retail sales of electricity of Dhaka Electric Supply Company Ltd. (DESCO) have been made effective in case of electricity usages from 01 September 2012 [7].

Table 2.1: Tariff rate of DESCO on 01 September 2012

SL	**Consumer Catagory**	**Per Unit Rate (TK.)**
1	**Category-A : Residential**	
	a. First Step : From 00 to 75 units	3.33
	b. Second Step : From 76 to 200 units	4.73
	c. Third Step : From 201 to 300 units	4.83
	d. Fourth Step : From 301 to 400 units	4.93
	e. Fifth Step : From 401 to 600 units	7.98
	f. Sixth Step : Above 600 units	9.38
2	**Category-B : Agricultural pumping**	2.51
3	**Category-C : Small Industries**	
	a. Flat Rate	6.95
	b. Off-Peak Time	5.96
	c. Peak Time	8.47
4	**Category-D : Non-Residential (Light and Power)**	4.53

5	**Category-E : Commercial And Office** A Flat Rate B Off-Peak Time C Peak Time	 9.00 7.22 11.85
6	**Category-F : Medium Voltage, General Purpose (11 KV)** A Flat Rate B Off-Peak Time C Peak Time	 6.81 5.96 9.33
7	**Category-H : High Voltage, General Purpose (33 KV)** A Flat Rate B Off-Peak Time C Peak Time	 6.48 5.87 9.14
8	**Category-J : Street Light and Water Pumps**	6.48

Bills Distribution Process:

After preparing the final bill, it is sent to the respective consumer by a messenger of DESCO. If the consumer does not get his bill of previous month on due date, he needs to contact with the local office.

Payment Options:

* When paying electricity bill, the consumer need to be kept his electricity bill.

* Cheque payment should be payable to “Dhaka Electric Supply Company limited”.

* Overdue and disconnected accounts can be paid only at any DESCO Authorized Payment Center[7].

Home and business users can pay their electricity bill through:

- Cash payment through Bank
- Auto debit system
- Easy pay machine
- GP Bill Pay Service
- Banglalink mobile cash point
- Citycell moneybag center
- DESCO Internet Bill Payment System[7]

DESCO introduced decentralized divisional customer service center with each sales and distribution division. From this center any customer can get the following services:

1. New connection
2. Load extension or revision
3. Service or site relocation
4. Consumer name change or tariff change
5. Meter test, Change etc.
6. Bill correction
7. Disconnected consumers service reconnection
8. Any other commercial related service
9. Customer information, awareness activity etc.

10. Pre-paid meter service

DESCO's has introduced pre-paid meter in one part of the capital Dhaka city.The pre-paid metered consumer expresses their satisfaction with this service for many reasons.

* E-Governance DESCO has implemented e-governance in their office management activity which promotes prompt customer service. Customer can enjoy dynamic web based billing and collection related information through internet[7].

Financial Reports:
The Financial Reports contain the following:

- Highlights of the Quarter,Half Year,Annual
- Balance Sheets
- Comparison of KWH Sales
- Statement of Retained Earnings
- Statement of Income [7]

Complain:
Any type of complains such as interruption of electricity, billing problems and others are informed by the consumer to the local office. The local office tries to solve the problem as early as possible. **Disconnect procedure** The power supply connection is disconnected for many reasons. If the payment is not paid within due time or for taking any unfair means by the consumer.

2.2.3 DPDC (Dhaka Power Distribution Company Limited)

Electricity plays a vital role in developing economy of a country in many ways. Dhaka Power Distribution Company Limited (DPDC) is the largest power distribution company in Bangladesh. As a part of the Power Sector Development and Reform program of the Government of Bangladesh (GOB) Dhaka Power Distribution Company Limited (DPDC) had been incorporated on 25th October, 2005 under the Company Act 1994 with an authorized

share capital of Tk. 10,000 (ten thousands) crore divided into 100 (One Hundred) crore ordinary share of Tk. 100 each[8].

The company was created to provide electricity to the consumers of Dhaka city corporation area (excluding DESCO areas) and also includingNarayangonj town, Siddirgonj, Fatullah and Mokterpur under Narayangonj district[8].

In its effort to enhance service delivery to its consumers, DPDC had adopted many measures, to name a few - Decentralization of the billing system with central monitoring; Opening of Bank booths in our NOCS premises; Bill payment through SMS and Grameenphone bill pay centers; On line complaint addressing tracking process to attend customer complaint within one hour; Displaying citizen charters in all of our NOCS premises; Simplification of new connection procedure; Issuing bill clearance certificate every year etc[8].

DPDC is pioneer in introducing remote metering (cellular SIM installed in the meter sending reading and other information) to upgrade the billing management activity. To simplify the consumer billing and its payment / collection and to establish transparency in revenue earning, DPDC is planning to bring in all the consumers (of domestic and commercial category) under prepaid metering system. Already ten thousand prepaid meter installation is in process and another one lac sixty thousand had been planned.DPDC is also upgrading the distribution network to accommodate additional 525 MVA load at 132/33 kV level and additional 557 MVA at 33/11 kV level by year 2013 [8].

For establishing a new connection, collecting utility bills and processing bills, it follows the same steps as DESCO. But the tariff rates are different. **Tariff Rate:**

Table 2.2: Tariff rate of DPDC

SL	Customer Category and Slab	Per Unit Rate (TK.)
1	**Category A: Residential**	
	A First Step: From 00 to 75 units	3.33
	B Second Step: From 75 to 200 units	4.73
	C Third Step: From 201 to 300 units	4.83
	D Fourth Step: From 301 to 400 units	4.93
	E Fifth Step: From 401 to 600 units	7.98
	F Sixth Step: From 601 to above	9.38
2	**Category B: Agricultural pumping**	2.51
3	**Category C: Small Industries**	
	A Flat Rate	6.95
	B Off-Peak Time	5.96
	C Peak Time	8.47
4	**Category D: Non-Residential (Light and Power)**	4.53
5	**Category E: Commercial and Office**	
	A Flat Rate	9.00
	B Off-Peak Time	7.22
	C Peak Time	11.85
6	**Category F: Medium Voltage, General Purpose (11 KV)**	
	A Flat Rate	6.81
	B Off-Peak Time	5.96
	C Peak Time	9.33

7	**Category G-2: Extra High Voltage, General Purpose (132 KV)** A Flat Rate B Off-Peak Time C Peak Time	 6.16 5.57 8.67
8	**Category H: High Voltage, General Purpose (33 KV)** A Flat Rate B Off-Peak Time C Peak Time	 6.48 5.87 9.14
9	**Category J: Street Light and Water Pumps**	6.48

Minimum charge, Demand charge, Service charge and other conditions prevailing in existing tariff and the Value Added Tax (VAT) fixed by National Board of Revenue of the Peoples Republic of Bangladesh will be applicable as it is with the above electricity tariff[8].

Bill Payment:

Users can pay their electricity bill through

- Cash payment through Bank(Bank booths in NOCS premises)
- GP Bill Pay Center
- Bill payment through SMS
- Online Bill Payment System (Southeast Bank Limited)

Services provided from one-stop service centers of DPDCare as follows:

- New Connection, Load Change, Account Name Change etc.

- Bill Related Complaint Handling
- Penal action for Illegal use of electricity, meter tempering, bypass etc.
- Land Phone and Mobile number of all NOCSes of DPDC[4].

2.2.4 REB (Rural Electrification Board)

The Rural Electrification Board of Bangladesh has been providing service to rural consumers for over 34 years.

The Bangladesh Rural Electrification (RE) Program was founded with a Presidential Ordinance in October 1977 that established the Rural Electrification Board (REB) as the semi-autonomous government agency reporting to the Ministry of Power Energy and Minerals Resources which was responsible for electrifying rural Bangladesh. Since its inception, the purpose of the program has been to use electricity as a means of creating opportunities for improving agricultural production and enhancing socio-economic development in rural areas, whereby there would be improvements in the standard of living and quality of life for the rural people[9].

Today there are 70 operating rural electric cooperatives called "PalliBidyuitSamity"(PBS), which bring service to approximately 93,31,204 new connection being made and more than 2,39,318 km of line has been constructed[9].

Enormous changes have occurred in areas all across rural Bangladesh due to people having access to electricity. The magnitude of changes and the impact of the RE Program is vast and diversified and information documenting these have become more acute in recent years. All stakeholders, particularly the Government of Bangladesh and the development partners need documentation that supports the large funding requirements that are needed to expand the program further[9].

Establishing New Connection:
For establishing a new connection at first the consumer has to apply to executive engineer or GM through a prescribed form. Form Rates are as follows:

- For Domestic: 100tk
- For Industry: 1000tk
- For Irrigation: 250tk

Then the office studies the feasibility of the connection. If the feasibility test is positive then the consumer have to deposit a security amount to the bank or office. After that the office establishes the new connection.

The local office is responsible for the maintenance and solves different complains from the consumer.

Line Construction Criteria:

1. Electrical Lines will be constructed according to priority serial no. of the Master Plan.

2. The minimum qualifying revenue is Tk.45, 000.00 (Taka Forty five thousand only) per year per kilometer.

3. The minimum qualifying revenue is Tk22, 500.00(Taka Twenty two thousand five hundred only) per year per kilometer for line conversion. If line conversion is required for system improvement then those revenue criteria will not be applicable but prior approval from System Engineering and Design Directorate will be needed[9].

Table 2.3: Anticipated revenue for different consumers

Sl. No	**Type of Consumer**	**Annual Revenue**
i)	Domestic (Load up to 1KW)	Tk.1,000.00
ii)	Domestic (If load is more than 1KW) per KW	Tk.1,000.00
iii)	Commercial (Load up to 1KW)	Tk.1.800.00
iv)	Commercial (If load is more than 1KW) per KW	Tk.1.800.00
v)	STW/LLP (Load up to 7.5 HP)	Tk.6,000.00
vi)	STW/LLP (If load is more than 7.5 HP)	Tk.15,000.00
vii)	DTW (If load is less than 25 HP)	Tk.15,000.00
viii)	DTW (If load is 25 HP or above)	Tk.30,000.00
ix)	Rice Mill/Saw Mill/Oil Mill/Flour Mill (3 Phase load up to 20 HP)	Tk.25,000.00
x)	Rice Mill/Saw Mill/Oil Mill/Flour Mill (3 Phase, If load is more than 20 HP but less than or equal to 40 HP)	Tk.35,000.00
xi)	Rice Mill/Saw Mill/Oil Mill/Flour Mill (Single)	Tk.14,000.00
xii)	Annual required revenue Tk.1, 000.00 (One thousand only) per year per Kilowatt of load for small industries or general power (Except Rice Mill/Saw Mill/Oil Mill/Flour Mill) upto 30 KW. and for CI Connection Annual required Revenue Per KW.	Tk.1, 000.00

Utility Bills Collection Process:

Consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises. He gets the meter reading in KWH.

The meter reader gets the cumulative reading from the meters. He then subtracts the previous meter reading from this reading and gets final reading for the current month. He submits the consumption information to the billing section from where the final bill is prepared.

Step 1: Unit consumption (KWH)* tariff rate from the energy provider= principal amount. Step 2: Principal amount+ capacity charge (Fixed) +demand charge+ VAT+ LPC (Late Payment Charge) = Total amount to be paid[9].

Tariff Structure in Rural Electrification Program:
In Rural Electrification Program, subject to established and regulations of the PalliBidyut-Samity, different tariffs are applied for the following type of consumers:

SCHEDULE - B (HOUSE or BARI): Applicable for single phase (50 cycles) electricity connection for Domestic and Household water pumps up to 1.5 HP.

SCHEDULE - C (COMMERCIAL): Applicable for single/three phase(50 cycles) electricity connection for Hat-Bazar, Shops, Commercial enterprises, Govt.and Semi-govt. offices, Private clinics, Practicing chambers, Community centers and community halls, Rest houses.

SCHEDULE - CI (CHARITABLE INSTITUTION): Applicable for single phase (50 cycles) electricity connection for Mosque, Temple, Church, School, College, Madrasha, Club, Orphanage, Charitable institution (not complexes), Charitable dispensary, Crippled rehabilitation center etc.

SCHEDULE - I (IRRIGATION): Applicable for single/three phase (50 cycles) electricity connection for all kinds of irrigation pumps.

SCHEDULE - GP (GENERAL POWER): Applicable for single/three phase(50 cycles) electricity connection (below 750 KVA load) for all types of industries and industrial complexes, Government office complexes, Government and charitable hospital complexes, Charitable, religious and education complexes, Domestic consumers having three phase connections, Small industries related to productions or fabrications, Cantonment, Air force and Naval base/installations etc., Police stations, Camps, Outpost etc. and Bangladesh Riffle

Camps, BOP, Installation etc.

SCHEDULE - LP (LARGE POWER): Applicable for single/three phase (50 cycles) electricity connection (load of 750 KVA or above) with Primary metering for all type of usage.

SCHEDULE - SL (STREET LIGHT): Applicable for single/three phase(50 cycles), electricity connection at the following types of consumer's premises: Mosque, Temple, Church, Public Park, Community Centre, Hat-Bazar, Village road, Sports club, Graveyard, Orphanage, Charitable and Public hospital, Dispensary or any place that serving general public.

The prepared bills are than distributed among the consumer by Messenger. **Bill Payment:** Users can pay their electricity bill through:

- Cash payment through Bank.
- Cash payment through UISC (Union Information and Service Center).
- Bill payment through SMS.
- Online Bill Payment System through bank(Janata Bank). [5]

2.3 Limitations of The Existing Meter Reading System

In Bangladesh the electricity billing system is completely manual called handheld system. The electricity meters are installed on consumers premises and the consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises. The disadvantages of the existing system are as follows:

1. The houses electric power meter is placed in a location where it is not easily accessible. Sometimes the meters are installed inside peoples homes and, if the Consumer is not at home, the meter-reader cannot record the fortnightly or monthly consumption and then the utilities company has to resort to considering the average bill-amount of the previous months as an indicator of the likely consumption for the current month. This results in burden for both consumer and the electricity supply company.May be the consumer has not utilized

similar amount of electricity in the current month as in the previous months for reasons such as, holidaying elsewhere or being in the hospital, etc. during the month, and sending him a bill for a larger amount based on his history of electricity consumption may result in his/her financial hardship. This method of billing is also not suitable for the electricity supply company because it gives inaccurate account of the overall electricity consumption in the consumers area and may ultimately result in errors in future planning by the company.

2. Sometimes the owner gives some extra money to the meter reader person to have less meter reading. As a result corruptions occur and actual payment is not received by the service provider. So the provider faces a huge amount of loss in every year.

3. With this human operator billing are prone to reading error.

4. Hiring of a number of meter readers by utilities companies and providing means of transportation to them is an expensive burden on the companies budgets.

5. It also requires a long working hour to achieve complete area data reading and billing.

6. Labor billing job is sometime restricted and slowed down by bad weather condition.

7. Printed billing has the tendency of losing in the mailbox.

CHAPTER 3

COMPARISON BETWEEN DIFFERENT METHODS

3.1 Background of AMR

The Automated Meter Reading (AMR) was first conceived in 1962 by ATT. After successful experiments, ATT offered to provide phone system-based AMR services at $2 per meter. The price was four times more than the monthly cost of a person to read the meter-50 cents. Thus the program was considered economically unfeasible[10].

In 1972, Theodore George "Ted"developed a sensor monitoring system which used digital transmission for security, fire and medical alarm systems as well as meter reading capabilities for all utilities. This technology was a spin-off of the automatic telephone line identification system, now known as Caller ID[11].

The modern era of AMR began in 1985, when several major full-scale projects were implemented. Hackensack Water Co. and Equitable Gas Go were the first to commit to full-scale implementation of AMR on water and gas meters, respectively. In 1986, Minnegasco initiated a 450,000-point radio-based AMR system. In 1987, Philadelphia Electric Co., faced with a large number of inaccessible meters, installed thousands of distribution line carrier AMR units to solve this problem. Thus, AMR is becoming more viable each day. Advances in solid-state electronics, microprocessor components and low cost surface-mount technology assembly techniques have been the catalyst to produce reliable cost-effective products capable of providing the economic and human benefits that justify use of AMR systems on a large, if not full-scale, basis[12].

3.2 Different Methods Other Than GSM

The primary driver for the automation of meter reading is not to reduce labor costs, but to obtain data that is difficult to obtain.AMR technologies include handheld, mobile and network technologies based on telephony platforms (wired and wireless), radio frequency (RF), or power line transmission. Some existing meter reading techniques are: Touch Technology AMR, Radio Frequency AMR (Handheld, Mobile or "Drive-by"meter reading and Fixed Network AMR), Power Line Communication AMR, Wi Fi.

3.2.1 Limitation of Other Methods

All of the above technology have some limitation and is not feasible for Bangladesh perspective. Their limitations are as follows:

1. In the touch technology, handheld technology and in mobile technology still the meter readers have to go to the houses, offices and other places where the meters are placed. So still the meter reader person is required. In addition we need extra devices which are very expensive. As a result they are not cost feasible[13].

2. The PLC technology is not also feasible for Bangladesh perspective. In Bangladesh high voltages transmits through the power line cable. As the voltage is high so the transmitted data will be corrupted by the attenuation. All the power line cable of our country is not placed under the ground. It situated in the open air. So the cable faces different environmental problems. So the actual data may not transmit to the provider end. As a result this technology is also not feasible in our country[13].

3. The fixed RF technology has small coverage area. As a result, this method consist of a number of series of antennas,towers, collectors, repeaters, or other permanently installed infrastructure to collect transmissions of meter readings from AMR capable meters. So this is not cost efficient for the customers[13].

Table 3.1: Performance of different systems

Performance	ZigBee	Bluetooth	Wi-Fi
Working frequency	2.4GHz 868/915MHz	2.4GHz	2.4GHz
Comm. range	0.1 1.5km	0.1km	0.1km
Data rate	250 Kbps	1Mbps	11Mbps
Low power consumption	support	No support	No support
System resource	4Kbyte 32Kbyte	250Kbyte	1Mbyte
Encryption	128 bits AES	128 bits	SSID
Wake-up time	30ms	10s	3s

3.3 GSM Module

A unique feature of GSM is the Short Message Service (SMS), which has achieved wide popularity as whatsome have called the unexpected killer application of GSM. SMS is a bi-directional service for sending short alphanumeric message in a store-and-forward process. SMS can be used both 'point-to-point'as well as in cell-broadcast mode. Supplementary services are provided on top of teleservices or bearer services, and include features such as, inter alia, call forwarding, call waiting, caller identification, three-way conversations, and call-barring.The most novel and far-reaching feature of GSM is that it provides most of Europes cellular phone users with a choice choice of network and choice of operator. Also, international roaming was and continues to be the cornerstone of GSM. For this to be possible, all networks and handsets have to be identical. With many manufacturers creating many different products in many different countries, each type of terminal has been put through a rigorous approval regime. However, at the time, no approval process was available, and it took nearly a year before the handheld terminals were tested and fit for market entry. Another of GSM's most attractive features is the extent to which its network is considered to be secure. All communications, both speech and data, are encrypted to prevent eavesdropping,

and GSM subscribers are identified by their Subscriber Identity Module (SIM) card (which holds their identity number and authentication key and algorithm). While the choice of algorithm is the responsibility of individual GSM operators, they all work closely together through the Memorandum of Understanding (MoU) to ensure security of authentication. This smart card technology minimizes the necessity for owning terminals - as travelers can simply rent GSM phones at the airport and insert their SIM card. Since its the card rather than the terminal that enables network access, feature access and billing,the user is immediately on-line[14].

3.3.1 Feature of Different GSM Modules

1. Sim-300:

* Uses the extremely popular SIM300 GSM module.

* Provides the industry standard serial RS232 interface for easy connection to computers and other devices.

* Provides serial TTL interface for easy and direct interface to microcontrollers.

* Power, RING and Network LEDs for easy debugging.

* Onboard 3V Lithium Battery holder with appropriate circuitry for providing backup for the modules internal RTC.

* Can be used for GSM based Voice communications, Data/Fax, SMS,GPRS and TCP/IP stack.

* Can be controlled through standard AT commands.

* Comes with an onboard wire antenna for better reception.

* Board provides an option for adding an external antenna through an SMA connector.

* The SIM300 allows an adjustable serial baud rate from 1200 to 115200 bps (9600 default).

* Modem a low power consumption of 0.25 A during normal operations and around 1 A during transmission.

* Operating Voltage: 7 15V AC or DC (board has onboard rectifier.

2. Q2406A:

* Flash memory 16MB, SRAM 2MB

* 3V SIM card slot

* DB9 RS232 interface without voice function

* SIM Application Toolkit

* Double tone multi-frequency function (DTMF)

* Maximum transmitting speed 115.2KB/s

* GRS Class 10

* Antenna with high sensitivity

* Always on-line

* Conform with ETSI GSM Phase2+

* Standard Output Power

* Class 4(2W @ 900MHz) and Class 1(1W @ 1800MHz)

* Input voltage 7.5V-30V DC Input current 1A-2A

* Working current: 100-140mA

* Working temperature -20 to +55 degrees

* Storage temperature -25 to -+70 degrees

* Size 76x54x25mm Weight 100g

3. Telit GM862:

* GSM Quad Band

* On Board SIM Holder

* GPRS Class 10

* Embedded TCP/IP Stack

* Embedded FTP and SMTP Client

* 17mA average stand-by, 3.5mA in low-power mode

* 250mA average operating current

* Data, Voice, SMS, and Fax

* Data speeds up to 57.6kbps

* Supply voltage: 3.4-4.2V

* MMCX Antenna Connector

* Extensive datasheets and forum support[15]

3.3.2 GSM and conventional meter reading

Table 3.2: Comparison between GSM and Conventional System

S.no.	Features	GSM based AMR System	Conventional Metering System
1	Remote Monitoring	Possible	Not Possible
2	Control the Domestic Energy Meter	Anywhere in the World	Only at respective Customer house
3	Tempering alert Feature	It provides tempering alert feature. In case of tempering, SMS alerts send to the electric company.	Not Possible.
4	Auto disconnect feature	It provides remote shut-off facilities to rouge customers that have large outstanding dues.	It does not provide auto disconnect feature.
5	Power cut Information feature	This system provides power cut information.	It does not provide power cut information.
6	Operation costs	Very less because we are accessing the system on request at any time without visiting person.	More because we require a person for accessing the system.
7	Data security	AMR system avoids meter reading error and reading data automatically also provides increased security of data.	In this system meter reading error possible and it provides less security of data.
8	Man power	No man power needed	Huge man power needed

3.4 Block Diagram of Present system

In present system a meter reader goes to the meter physically and read data once in a month. Then the meter reader submits that data to the service provider office. Then the service provider office calculates the energy consumption and generate bill against each consumer. After that the bill is sent to the consumer through a messenger or mail service. If the consumer has any complain, he submits that in the local office otherwise pays the bill through a financial institution.

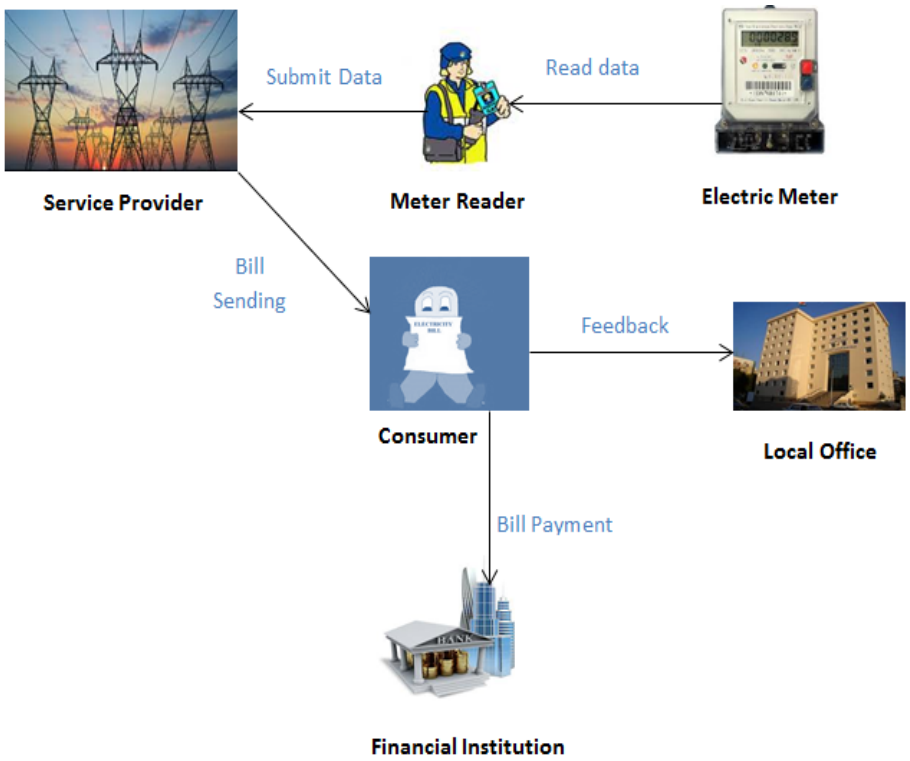

Figure 3.1: Present system of meter reading

In this system consumer and service provider communication is manual.There is a huge chance of error.Service provider cant monitor the real time situation.Service provider has less chance to receive feedback from consumer.

3.5 Block Diagram of Automated System with GSM

In this system there is an embedded system inside the meter with GSM module. It sends data in certain period of month automatically to the service providers server. Then the bill is calculated in the server and sent to the consumer through SMS or email. Then the consumer can pay the bill through online banking or conventional ways.

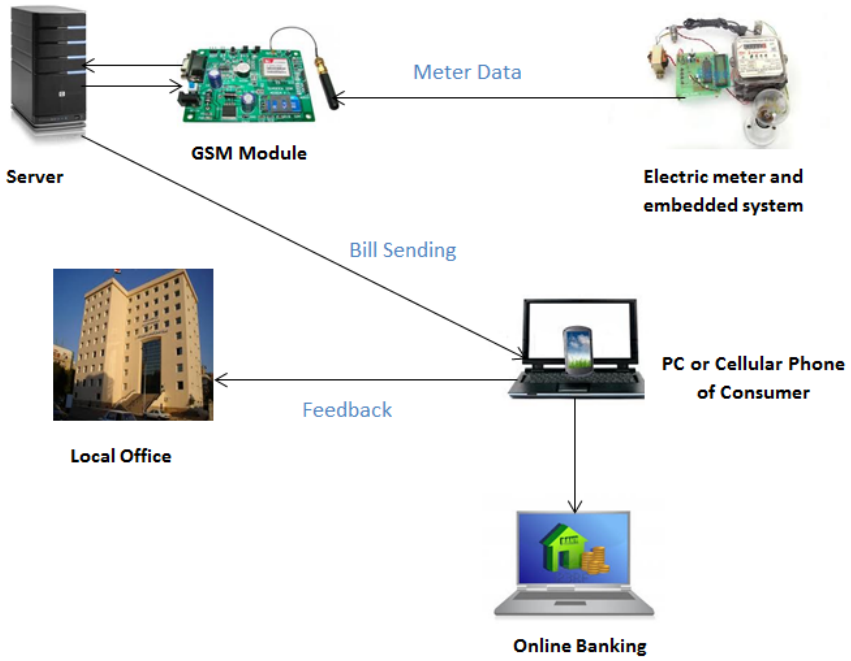

Figure 3.2: Block Diagram of Automated system

CHAPTER 4

PROTOTYPE DESIGN

4.1 Hardware Design

In this proposed system we will design the messaging procedure of consumer end for an electricity meter. In the Hardware design we will discuss the component used, block diagram of circuit etc.

The connection diagram from the LCD monitor of electric energy meter to GSM module is shown in the figure below. As an interfacing device between LCD and GSM we used ATMEGA 16 microcontroller.The design is done in proteus 7.7 simulator, as GSM module replacement in design we used COMPIM.This part of circuit is implemented in consumer end.

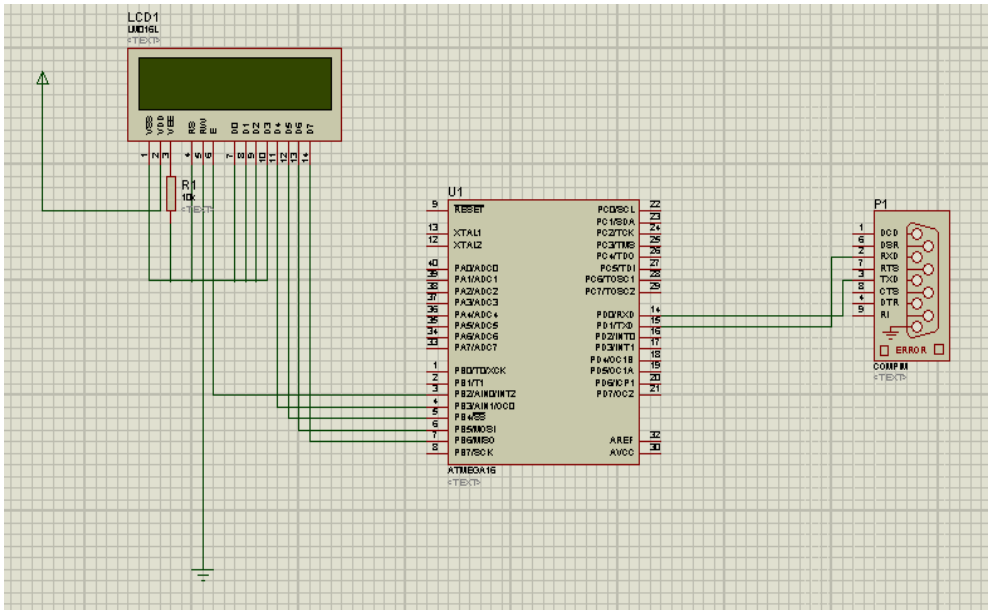

Figure 4.1: Schematic diagram of Meter to GSM connection

The connection between GSM module to Server computer is shown below with a schematic diagram. This connection uses MAX232 and ATMEGA 16 in between GSM and Server. This is implemented on server side of service provider end.

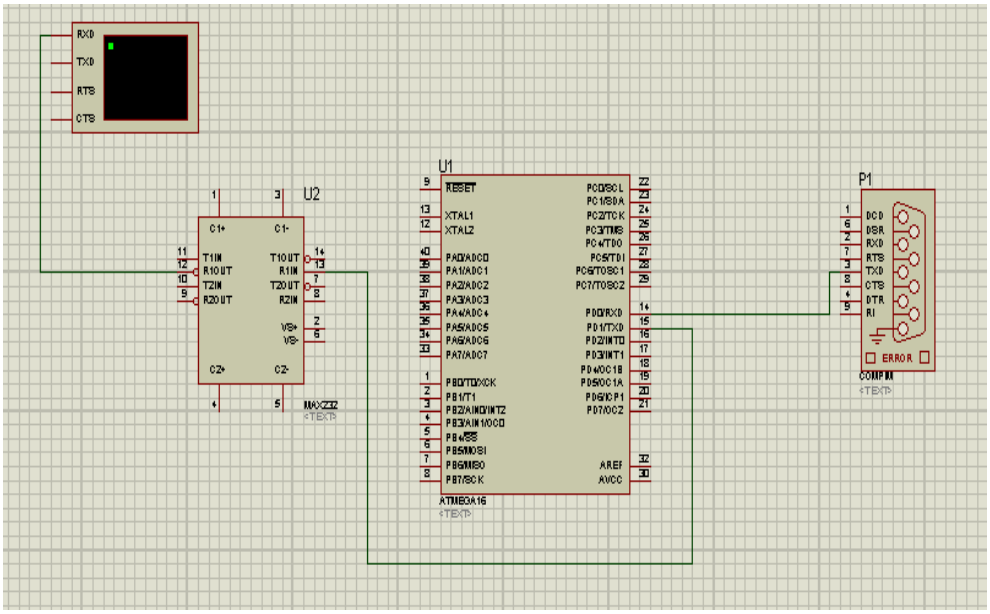

Figure 4.2: Schematic diagram of GSM to PC communication

4.1.1 Microcontroller

Microcontroller is used to integrate the digital electricity meter with the GSM module. A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications[16]. There are mainly two kinds of microcontroller is in use now a days Atmel AVR or PIC. The AVR is a modified Harvard architecture 8-bit RISC single chip microcontroller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time[17].

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller". PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability[18].

We will use ATMEGA-16 microcontroller of Atmel AVR family because of its availability, efficiency and low cost.

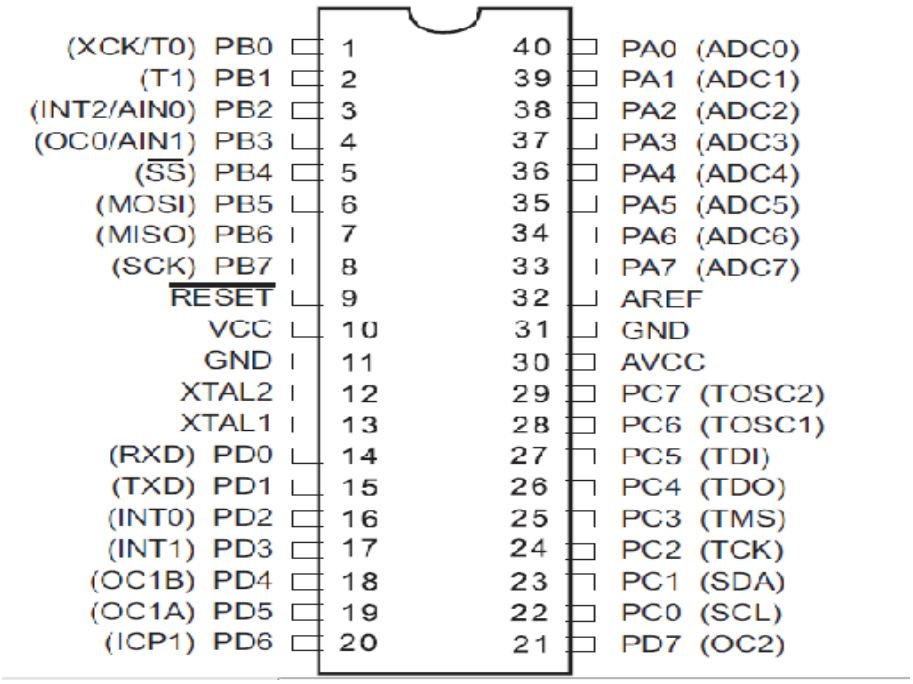

Figure 4.3: Pin diagram of ATmega 16

Features of ATmega 16 are as follows:

- High-performance, Low-power Atmel AVR 8-bit Microcontroller
- Advanced RISC Architecture
- 131 Powerful Instructions - Most Single-clock Cycle Execution
- 32 x 8 General Purpose Working Registers
- Fully Static Operation
- Up to 16 MIPS Throughput at 16 MHz
- On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory segments
- 16 Kbytes of In-System Self-programmable Flash program memory
- 512 Bytes EEPROM

- 1 Kbyte Internal SRAM
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data retention: 20 years at 85/100 years at 25
- Optional Boot Code Section with Independent Lock Bits
- In-System Programming by On-chip Boot Program
- True Read-While-Write Operation
- Programming Lock for Software Security [19]

4.1.2 Max 232 module

This module comes in handy to work with RS232 communication. Max232 IC changes the RS232 level to TTL level. This module has all the necessary components that max232 needs to operate, with the entire necessary pin out and a serial port female connector (DB9F). The

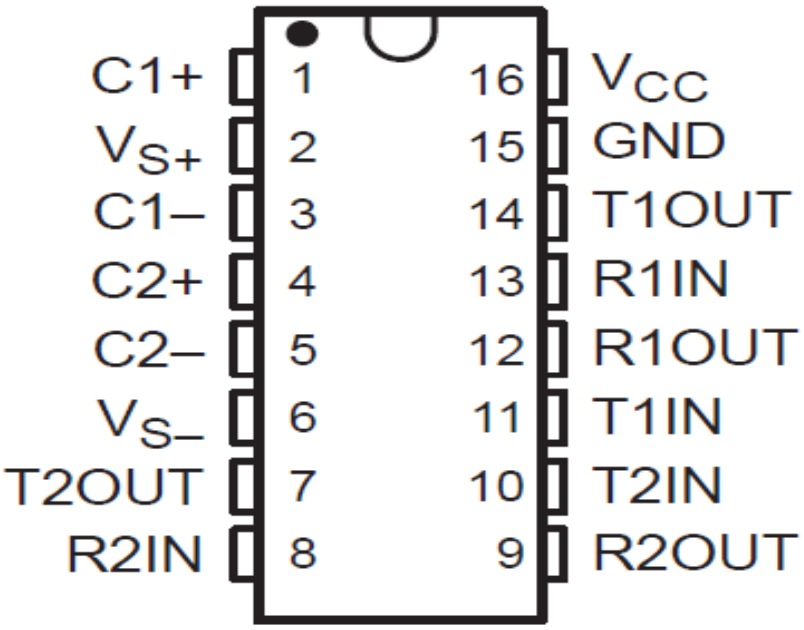

Figure 4.4: MAX 232 pin diagram

MAX232 device is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a

typical hysteresis of 0.5 V, and can accept 0-V inputs. Each driver converts TTL/CMOS input levels into EIA-232 levels. The driver, receiver, and voltage-generator functions are available as cells in the Texas Instruments LinASICE library. The MAX232 is characterized for operation from 0 to 70. The MAX232I is characterized for operation from -40 to 85.

4.1.3 SIM 900

Designed for global market, SIM 900 is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM 900 features GPRS multi-slot class 10/class 8(optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 24x24x3 mm, SIM 900 can meet almost all the space requirements in user applications, such as M2M, smart phone, PDA and other mobile devices.SIM 900 has 68 SMT pads, and provides all hardware interfaces between the module and customer boards.

- Serial port and debug port can help user easily develop user's applications
- Audio channel which includes a microphone input and a receiver output.
- Programmable general purpose input and output.
- The keypad and SPI display interfaces will give user the flexibility to develop customized applications.

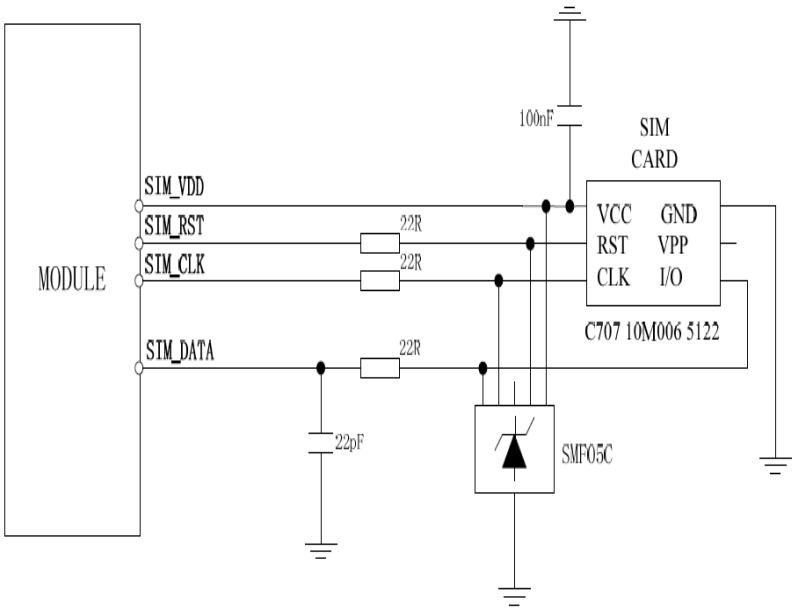

Figure 4.5: Circuit diagram of SIM connection

SIM 900 is designed with power saving technique so that the current consumption is as low as 1.0mA in sleep mode. SIM 900 integrates TCP/IP protocol and extended TCP/IP AT commands which are very useful for data transfer applications[20].

4.2 Software Design

There are two parts in the software design, the server side and the consumer side. We designed two separate algorithms for both the sides.

4.2.1 Algorithms

At first we will design algorithm for sending SMS from consumer side to server.

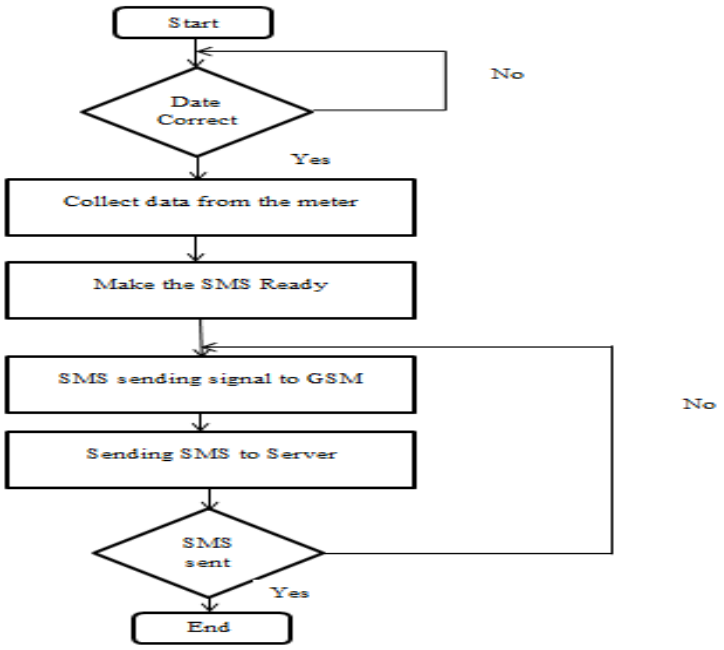

Figure 4.6: Flow chart for SMS sending

At the server side following algorithm will be implemented.

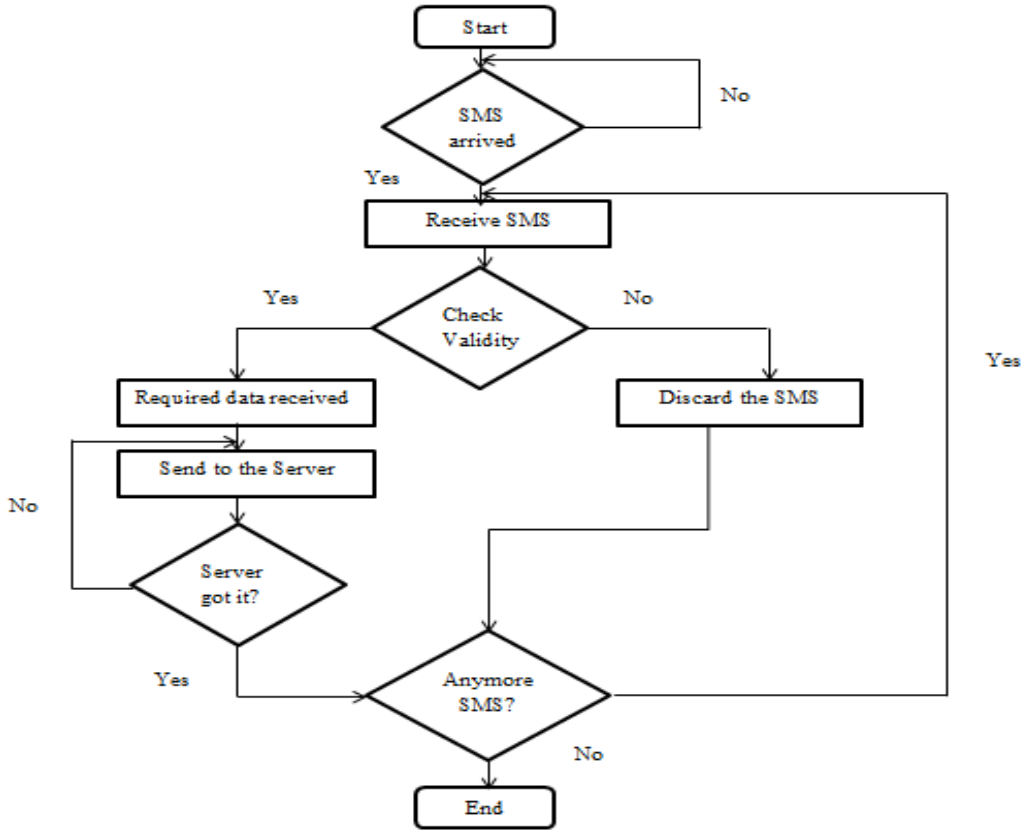

Figure 4.7: Flow chart for SMS receiving

CHAPTER 5

CONCLUSION

5.1 Limitations

In the proposed system described in this paper, we did not design any separate software for the server side data processing. The designed prototype is based on electricity meter only. It will need modifications to use in water and gas meters. The prototype will only work for digital meter not for analog one. After the prototype design we tested it with electricity meter made by one company only, it may have some technical difficulties with meters made by other companies. We only focus on making the meter reading automated, but there are scopes to make automation in connectivity and billing process too.

5.2 Future Expansion

- The process of new connection can be made online.
- Remote controlling of meter can be added.
- Alerting the user about their daily consumption through SMS can be done, which will help to reduce energy consumption.
- The whole electricity, water and gas billing system can be integrated.
- The auto remote disconnection and reconnection procedures can be implemented.

5.3 Conclusion

Automated Meter Reading system can change the whole scenario of utility management of Bangladesh. Establishment of Automated Meter Reading will make the whole system faster, consumer friendly, 0% error management can be possible. Also it will help both consumers and providers to make the whole utility system more energy efficient. Moreover, it will reduce the service costs for the service providers as no manpower for meter reading will be required. There will be no scope of corruption in the system which will generate huge revenue for the Government. It will help to solve the energy crisis of Bangladesh in near future.

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APPENDIX A

APPENDIX B