1. **INTRODUCTION**

The project “Automated Electricity Meter” aims to move away from the traditional method of manual reading of electricity meters in which an individual has to physically record the reading. Instead the project proposes to successfully be able to take the meter reading automatically without having a person be physically present while taking the reading, thereby reducing manpower requirement. As the project name suggests, the vision of our project is to create an automated environment for the purpose of meter readings and thus reduce the dependency on human resources. Thus the ‘Automated meter’ would be the representative of the company for the purpose of taking readings without involving human error.

**1.1 BACKGROUND**

**1.1.1 DESCRIPTION OF ELECTRIC METER**

An **electric meter** or **energy meter** is a device that measures the amount of electrical energy consumed by a residence, business organisation, or an institution.

Electric meters are typically calibrated in billing units, the most common one being the kilowatt hour. Periodic reading of electric meters establishes billing cycles and energy used during a cycle.

When energy savings during certain periods are desired, meters may measure demand, the maximum use of power in some interval. In some areas, the electric rates are higher during certain times of day, to encourage reduction in use. Also, in some areas meters have relays to turn off nonessential equipment.



Fig 1.1.1.a: A contemporary meter

**1.1.2 PROBLEMS ASSOCIATED WITH CONTEMPORARY METERS**

Even though the contemporary meters are widely used, there are many shortcomings associated with it, viz.

1. Inefficient use of Labour force

In today’s time when skilled labour force is limited not easily and cheaply available, it is highly impractical and not cost effective for electrical energy supplying companies to employ human resources for just collecting reading from various individual consumers.

1. Indication of Short Circuits

Contemporary meters are incapable of indicating any kind of short circuit or any other mishappenings with the meter.

1. Faulty Meter readings

Many a times, due to human shortcomings it so happens that the meter readings get interchanged at the time of reading and the consumer is charged for the electricity he hasn’t used. This may also take place intentionally due to personal grudges and avarice.

1. Time Consuming

Since the entire process requires human force to be present at each of the remote location to record the reading and hence it is time consuming.

**1.2 ELECTRICAL POWER MEASUREMENT**

Power (P) is a measure of the rate of doing work or the rate at which energy is converted. Electrical power is the rate at which electricity is produced or consumed. Electric power is the combination of the water pressure (voltage) and the rate of flow (current) that results in the ability to do work. Electrical power is defined as the amount of electric current flowing due to an applied voltage. It is the amount of electricity required to start or operate a load for one second. Electrical power is measured in watts (W).

Electrical energy introduces the concept of time to electrical power. In the water analogy, it would be the amount of water falling through the pipe over a period of time, such as an hour. When we talk about using power over time, we are talking about using energy. Using our water example, we could look at how much work could be done by the water in the time that it takes for the tank to empty.

The electrical energy that an appliance or device consumes can be determined only if you know how long (time) it consumes electrical power at a specific rate (power). To find the amount of energy consumed, you multiply the rate of energy consumption (measured in watts) by the amount of time (measured in hours) that it is being consumed. Electrical energy is measured in watt-hours (Wh).

One watt-hour is a very small amount of electrical energy. Usually, we measure electrical power in larger units called kilowatt-hours (kWh) or 1,000 watt-hours (kilo = thousand). A kilowatt-hour is the unit that utilities use when billing most customers.

Energy (E) = Power (P) x Time (t)

E = W x h = Wh

The number of units consumed by a 60 W bulb for a month for a average residential unit in an metropolitan city is 15. Considering the overall consumption of the residential unit to vary anywhere between 100 to 300, the amount to be payed by the consumer to the energy supplier only for a 60 W bulb is

Amount= 15\*5.56

= 83.4

**1.3 AUTOMATED METER**

An **automated meter**, is an advanced meter (usually an electrical meter) that records consumption at all instants and communicates the reading information via wireless network back to the central system for monitoring and billing purposes (telemeter) as per the requirement and regulation of the energy supplier . It enables two-way communication between the meter and the central system.

BLOCK DIAGRAM

Fig 1.3.a: Block diagram of AEMS

METER 1

METER 2

CENTRAL SYSTEM

The above figure shows the block diagram of the automated electricity meter which consists of a central system and individual meters. The individual meters and the central system communicate with each other via a wireless network.

**1.3.1 FUNCTION OF METER BLOCKS:**

The meter records the consumption of electrical energy of a particular institution such as a household or an industry. It contains the meter readings of the previous twelve months and can transmit the recorded readings whenever required by the Central System.

**1.3.2 FUNCTIONS OF THE CENTRAL SYSTEM:**

The Central System is the master of all the meters in the network and controls their operations. It issues various signals to the meters connected in the network to which they reciprocate by transmitting the required data.

1.3.3 COMMUNICATION PROCESS:

The process is a duplex communication system. The individual meters respond to the different signals issued by the central system by deciphering them.

The different signals issued by the central system have a unique combination code.

For each combination, the meters act accordingly and transmit the required data.

00: This code is broadcasted at the end of the billing period. On receiving this signal the meters send their recorded reading one at a time. After transmitting the reading, the meter counter is reset.

01: When ’01’ is transmitted by the central system, the meter on receiving the code sends the meter reading of the same month but of the previous year.

10: When ‘10’ is transmitted by the central system, the meter receives the signal and transmits the current meter reading which indicates the number of units of electricity consumed. However, the meter counter is not reset and continues to measure the power usage from the same reading.

11: Whenever the energy supplier wishes to stop the operation of the meter , the central system will transmit a ‘11’ code. On receiving this code, the meter stops all operation and shuts down.

Like the central system, the meter also sends signals to the central system via the wireless network.

1: Whenever there is a short circuit scenario, the meter would inform the central system by transmitting a ‘1’ code.

**2. REVIEW OF LITERATURE**

**2.1 ATMEGA 32:**

The ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC Architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

**2.1.1 Features of Atmega32:**

• High-performance, Low-power 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

– 32K Bytes of In-System Self-programmable Flash program memory

– 1024 Bytes EEPROM

– 2kB Internal SRAM

– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

– Data retention: 20 years at 85°C/100 years at 25°C

– Byte-oriented Two-wire Serial Interface

– Programmable Serial USART

– Master/Slave SPI Serial Interface

– Programmable Watchdog Timer with Separate On-chip Oscillator

– On-chip Analog Comparator

• Special Microcontroller Features

– Power-on Reset and Programmable Brown-out Detection

– Internal Calibrated RC Oscillator

– External and Internal Interrupt Sources

– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby

and Extended Standby

• I/O and Packages

– 32 Programmable I/O Lines

– 40-pin PDIP, 44-lead TQFP, and 44-pad QFN/MLF

• Operating Voltages

– 2.7 - 5.5V for ATmega32L

– 4.5 - 5.5V for ATmega32

• Speed Grades

– 0 - 8 MHz for ATmega32L

– 0 - 16 MHz for ATmega32

• Power Consumption at 1 MHz, 3V, 25°C for ATmega32L

– Active: 1.1 mA

– Idle Mode: 0.35 mA

– Power-down Mode: < 1 μA

**2.1.2 PIN CONFIGURATION AND DESCRIPTION:**

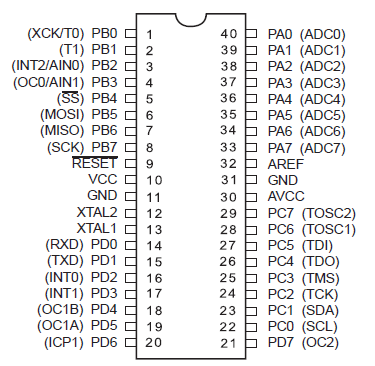


Fig 2.1.2.a: Pin configuration of Atmega32

VCC: Digital supply voltage

GND: Ground

PORT A (PA7..PA0) : Port A serves as the analog inputs to the A/D Converter.

Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

PORT B (PB7..PB0): Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

PORT C (PC7..PC0): Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs. The TD0 pin is tri-stated unless TAP states that shift out data are entered.

PORT D (PD7..PD0): Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

RESET: Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. Short pulses are not guaranteed to generate a reset.

XTAL1: Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2: Output from the inverting Oscillator amplifier.

AVCC: AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

AREF: AREF is the analog reference pin for the A/D Converter.

**2.1.3 USART**

The Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART) is a highly flexible serial communication device.

The main features are:

• Full Duplex Operation (Independent Serial Receive and Transmit Registers)

• Asynchronous or Synchronous Operation

• Master or Slave Clocked Synchronous Operation

• High Resolution Baud Rate Generator

• Supports Serial Frames with 5, 6, 7, 8, or 9 Data Bits and 1 or 2 Stop Bits

• Odd or Even Parity Generation and Parity Check Supported by Hardware

• Data OverRun Detection

• Framing Error Detection

• Noise Filtering Includes False Start Bit Detection and Digital Low Pass Filter

• Three Separate Interrupts on TX Complete, TX Data Register Empty, and RX Complete

• Multi-processor Communication Mode

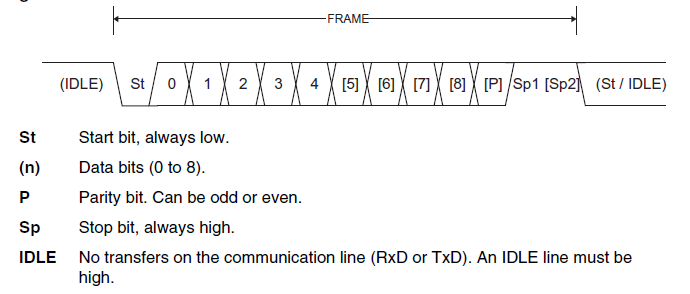
• Double Speed Asynchronous Communication Mode

**2.1.4 FRAME FORMAT**

A serial frame is defined to be one character of data bits with synchronization bits (start and stop bits), and optionally a parity bit for error checking. The USART accepts all 30 combinations of the following as valid frame formats:

* 1 start bit
* 5, 6, 7, 8, or 9 data bits
* no, even or odd parity bit
* 1 or 2 stop bits

A frame starts with the start bit followed by the least significant data bit. Then the next data bits, up to a total of nine, are succeeding, ending with the most significant bit. If enabled, the parity bit is inserted after the data bits, before the stop bits. When a complete frame is transmitted, it can be directly followed by a new frame, or the communication line can be set to an idle (high) state.



The frame format used by the USART is set by the UCSZ2:0, UPM1:0, and USBS bits in

UCSRB and UCSRC. The Receiver and Transmitter use the same setting. Note that changing the setting of any of these bits will corrupt all ongoing communication for both the Receiver and Transmitter.

Parity Bit Calculation

The parity bit is calculated by doing an exclusive-or of all the data bits. If odd parity is used, the result of the exclusive or is inverted. The relation between the parity bit and data bits is as follows:



Peven: Parity bit using even parity

Podd: Parity bit using odd parity

dn: Data bit n of the character If used, the parity bit is located between the last data bit and first stop bit of a serial frame.

2.1.5 IN-SYSTEM FLASH PROGRAM MEMORY

The ATmega32 contains 32K bytes On-chip In-System Reprogrammable Flash memory for program storage. Since all AVR instructions are 16 or 32 bits wide, the Flash is organized as 16K x 16. For software security, the Flash Program memory space is divided into two sections, Boot Program section and Application Program section.

The Flash memory has an endurance of at least 10,000 write/erase cycles. The ATmega32 Program Counter (PC) is 14 bits wide, thus addressing the 16K program memory locations.

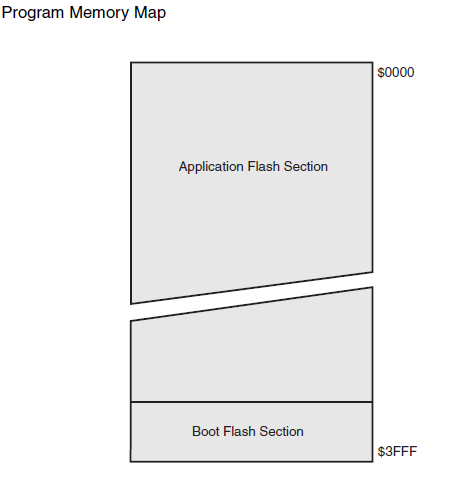


Fig 2.1.5.a: Program memory map of Atmega32

**2.1.6 SRAM DATA MEMORY**

The lower 2144 Data Memory locations address the Register File, the I/O Memory, and the internal data SRAM. The first 96 locations address the Register File and I/O Memory, and the next 2048 locations address the internal data SRAM. The five different addressing modes for the data memory cover: Direct, Indirect with Displacement, uIndirect, Indirect with Pre-decrement, and Indirect with Post-increment. In the Register File, registers R26 to R31 feature the indirect Addressing Pointer Registers.

The direct addressing reaches the entire data space.

**2.1.7 EEPROM DATA MEMORY**

The ATmega32 contains 1024 bytes of data EEPROM memory. It is organized as a separate data space, in which single bytes can be read and written. The EEPROM has an endurance of at least 100,000 write/erase cycles. The access between the EEPROM and the CPU is described in the following, specifying the EEPROM Address Registers, the EEPROM Data Register, and the EEPROM Control Register

**2.2 ATMEGA 8:**

**2.2.1 Features:**

The features of Atmega 8 are very similar to that of Atmega 32 with the only difference being that Atmega 8 has 8 K Bytes of In-System Self-programmable Flash program memory in contrast to the 32 K Bytes of Atmega 32. Thus it can be used for purposes where the memory requirement is not very large and smaller memory can serve the purpose.

**2.2.2 PIN CONFIFURATION AND DESCRIPTION:**

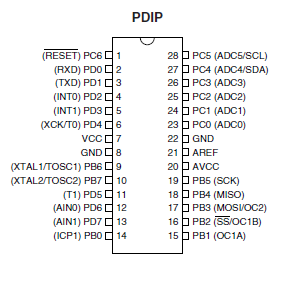


Fig 2.2.2.a: Pin configuration of Atmega8

VCC: Digital supply voltage

GND: Ground

PORT A (PA7..PA0) : Port A serves as the analog inputs to the A/D Converter.

Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes \active, even if the clock is not running.

PORT B (PB7..PB0) XTAL1/XTAL2/TOSC1/TOSC2: Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier. If the Internal Calibrated RC Oscillator is used as chip clock source, PB7..6 is used as TOSC2..1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

PORT C (PC5..PC0) : Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

PC6/RESET: PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Short pulses are not guaranteed to generate a Reset.

PORT D (PD7..PD0): Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

RESET: Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. Short pulses are not guaranteed to generate a reset.

AVCC: AVCC is the supply voltage pin for the A/D Converter, Port C (3..0), and ADC (7..6). It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that Port C (5..4) use digital supply voltage, VCC.

AREF: AREF is the analog reference pin for the A/D Converter.

ADC7..6 (TQFP and QFN/MLF Package Only): These pins are powered from the analog supply and serve as 10-bit ADC channels.

**2.3 ASK MODULE**

The ST-TX01-ASK is an ASK Hybrid transmitter module. The ST-RX02-ASK is an ASK Hybrid receiver module. They are designed by the Saw Resonator, with an effective low cost, small size, and simple-to-use for designing.

2.3.1 THE ASK TRANSMITTER AND RECEIVER MODULES ARE SHOWN BELOW:

ASK TRANSMITTER ASK RECIEVER

2.3.2 THE PIN DIAGRAMS OF THE TRANSMITTER AND RECEIVER SECTIONS ARE SHOWN BELOW:



2.3.3 THE FEATURES OF ASK TRANSMITTER AND RECEIVER ARE:

|  |  |
| --- | --- |
| ASK TRANSMITTER | ASK RECIEVER |
| Frequency Range:315 / 433.92 MHZ | Frequency Range:315 / 433.92 MHZ |
| Output Power : 4~16dBm | Typical sensitivity: -105dBm |
| Supply Voltage: 3~12V | Supply Current: 3.5mA |

**2.3.4 THE TYPICAL APPLICATIONS OF THE ASK TRANSMITTER AND RECEIVER MODULES ARE**:

* Car security system
* Wireless security systems
* Sensor reporting
* Automation system
* Remote Keyless entry

**3. PROBLEM FORMULATION**

Generally any kind of measurement is associated with physical presence of an individual to record the reading and update the database system. The fundamental problem with such conventional measurement techniques is the inefficient use of human resource which can be used for more beneficial purposes. This work is an added burden on the human resource which is already scarce in most of the countries.

There are other limitations to conventional measurement techniques viz. faulty meter reading and wastage of time. Many a times, due to human shortcomings it so happens that the meter readings get interchanged at the time of reading and the consumer is charged for the electricity he hasn’t used. This may also take place intentionally due to personal grudges and avarice. Moreover, the entire process requires human force to be present at each of the remote location to record the reading and hence it is time consuming.

Thus if a system is developed which bypasses the requirement of labour force and at the same time gives accurate readings of the meter along with other miscellaneous indications about the meter to the central system, it will definitely increase the efficiency and accuracy involved in the measurement of readings. The security of the data (meter reading) can be ensured with the help of encryption so that it is not tampered with or misused. However with the positives of the system, we need to look at the possible problems that we can face in the long run viz. correct transmission of data from the meter to the central system, large range so as to make the system practically realizable, channel switching so as to cater to a large number of meters.

**4. PROPOSED PROBLEM SOLUTION**

The project can be majorly divided into three discrete parts:

1. METER READING

2. TRANSMISSION OF RECORDED DATA

3. POST RECEPTION PROCESSING

4. INDICATION OF SHORT CIRCUIT

**4.1** **METER READING**

Every electric meter has a counting device or a circuit whose count value changes depending upon the consumption of energy. The more the consumption, the more is the count value. If a large number of electric units are being consumed at the same instant, the counter counts at a higher rate.

In our project, we are not making an electric meter as meter solutions are already available in the market. We will just be showing the prototype of the meter and depict its working using a microcontroller which will anyways be used in our system.

**4.1.1 DEPICTING THE METER:**

In order to depict the working of a meter, we will be using the in built COUNTERS of the controller to increase the count value. As long as there is only device connected to the meter, there is no problem in the process of incrementing the COUNT value. The problem arises when a number of loads are simultaneously ON, because of which the counter counts at a faster rate than normal. In order to solve this issue of having variable counting rates, we will be using a technique in which *multiple* counters are involved.

Consider the figure shown below, it consist of an Atmega8/Atmega32 microcontroller and a few LEDs which are connected to the pins of the microcontroller. The LEDs are to indicate the various loads that are present at the meter from which it calculates the number of units consumed.

Fig 4.1.1.a: Illustration of working of the meter

Consider the figure shown above, it consist of an Atmega8/Atmega32 microcontroller and a few LEDs which are connected to the pins of the microcontroller. The LEDs are to indicate the various loads that are present at the meter from which it calculates the number of units consumed.

COUNTER1,COUNTER2 ….COUNTERN are the different counters that are available through the microcontroller by way of in-built counters and registers which can easily be used as counters.

Case 1: When LED1 is ON

When LED1 is ON, the corresponding pin of the microcontroller will get a HIGH. Once it receives the signal, the counter increases the count value. While incrementing the count value, it samples the input at that pin to check if the input is still HIGH. The moment the input changes to LOW, the counter stops counting and registers a certain count.

All this while, COUNTERS (2 to N) were not counting and had the previous count value stored in them.

TOTALCOUNT=COUNT1+COUNT2+…………………COUNTN

In this case, only COUNT1 was active and hence TOTALCOUNT=COUNT1.

Case 2: When LED1& LED2 are ON

When the input to both the pins are HIGH, both the counters are activated and start counting. This process goes on till either or both of LEDS(appliances) are switched off. In this case as more than one appliance was ON, two counters were used and the total count is the sum of the count values of both the counters.

TOTALCOUNT=COUNT1+COUNT2

Case 3: When LED1, LED2………..LEDN are ON

When the input to the N number of pins are HIGH,’N’ counters are activated and start counting. The different counters go on counting till the input at that particular pin becomes ‘0’. Once that happens, the corresponding counter stops counting. Here the total count is the sum of count values of the ‘N’ counters.

TOTALCOUNT=COUNT1+COUNT2+…………………COUNTN

Thus with the help of multiple counters, the problem of variable counting rate is solved.

These totalcount values of the different meters in our network will be taken at regular intervals and then transmitted using the RF transreceiver module present at each meter to a centralized system (in our case a computer) which will represent the main station of the energy supplier. This meter reading of each meter is then updated in the corresponding database of the consumer and the consumer is charged accordingly as per the tariff of the energy provider.

**4.2** **TRANSMISSION AND RECEPTION OF DATA**

For the purpose of sending of data (recorded meter reading and other control messages emerging from the central system to the individual meters) we plan to use wireless transmission techniques. There are a lot of options that can be considered for the purpose of wireless transmission of data such as ASK transreceiver modules, FSK transreceiver modules, Bluetooth modules, Xbee modules,etc. Each of the above said modules have their own advantage and disadvantage with respect to the cost, range, noise immunity , accuracy and complexity. It is therefore, necessary to strike a balance between the various parameters so that the purpose is successfully served.

We have two economical modulation techniques to be considered whose comparison is given below.

|  |  |  |  |
| --- | --- | --- | --- |
| SERIAL NO. | PARAMETER | ASK | FSK |
| 1. | VARIABLE CHARACTERISTIC | AMPLITUDE | FREQUENCY |
| 2. | BANDWIDTH | 2fb | 4fb |
| 3. | NOISE IMMUNITY | LOW | HIGH |
| 4. | COMPLEXITY | SIMPLE | MODERATELY COMPLEX |
| 5. | BIT RATE | SUITABLE UPTO 100 BITS /SEC. | SUITABLE UPTO 1200 BITS/SEC. |
| 6. | DETECTION METHOD | ENVELOPE | ENVELOPE |

Even though the performance of ASK is low as compared to FSK, due its low bandwidth requirement and lesser complexity in the module, we decided to use the ASK module in our system for the purpose of transmission. Also as our project is going to be a modular prototype of a future advanced meter system, hence there is no need of having a very large range of transmission and thus ASK transmission and reception would certainly suffice our purpose.

Thus, We are making use of a RF transreceiver module (TX -RX pair-433.92 MHZ) that uses ASK(Amplitude Shift Keying) modulation technique for the purpose of the transmission both at the meter as well as the central system.

This Tx-Rx module works at a transmission frequency of 433.92 MHZ and has a typical range of 100 meters under standard conditions.It is also characterised by high sensitivity and low power consumption.the output power from the transmitter is around 4-12 dbm. The frequency of reception of the receiver is 433 MHZ with an operating voltage of 5V. Some of its applications are remote controls, sensor reporting, car security system, etc.

**4.2.1 TRANSMISSION PROCESS:**

Once the meter reading is obtained, it is then encrypted to avoid any kind of tampering and maintain security and then given to the transmitter module along with other additional bits for channel and meter selection. the data is sent in the form of frames which consist of a start bit to indicate start of transmission and a stop bit to indicate the end of transmission.

**4.3**. **POST RECEPTION PROCESSING**

The obvious limitation of all microcontrollers is the size of flash memory required to store the received recorded meter reading of the consumers. Atmega32 has a maximum of 32kB of flash memory which is insufficient to store the database of the consumers and their electricity usage data. Thus, it is essential to make use of a computing device like a computer to do the post reception processing of data received. Moreover, other actions like billing, sending SMS’s, uploading the database on the internet can easily be done using the computer which will become much faster and simpler.

The post reception of the transmitted data basically includes taking the data from the receiving antenna, decrypting it and then updating it in the system for further use such as updating database and giving an account of the usage to the consumers. In the post reception, we will be basically deal with the billing of consumers and other allied services required by the consumer.

**4.4 INDICATION OF SHORT CIRCUIT**:

The AEMS system will also help inform the energy supplier about the occurrence of a short circuit at the side of the consumer. In order to implement this feature, we will be making use of a circuit breaker along with other circuits.

In normal power supply, the electricity from the mains goes to the appliances via a fuse or a circuit breaker in order to provide protection at the time of any mishap. If there is any kind of short occurring, then the appliance is disconnected from the mains, thereby not causing any damage. In our system, the detection of short will be detected in the following way:

CENTRAL MAINS

CIRCUIT BREAKER

APPLIANCE

MCU

RECTIFIER

Figure 4.4.a: Block Diagram for Indication of Short Circuit

In our system, we have a circuit breaker circuit in between the central mains and the appliance. The output of the circuit breaker goes to a pin of the microcontroller through a rectifier. As long as there is no short, the circuit breaker will be deactivated and present in the circuit, and hence there will be a certain output which also goes to the controller. The moment a short circuit occurs, the circuit breaker will be activated and circuit will become open. As a result there will not be any output from the circuit breaker and thus no voltage will be developed at the pin

At all instants the controller keeps on sampling the input pin from the circuit breaker and whenever it finds a ZERO at the pin it realizes that the circuit breaker has got activated and a short circuit has occurred, thus the central system can be easily informed about the occurrence of the short circuit.

**FUTURE SCOPE**

There is no doubt about the potential benefits of automation. automated meter appear to be the biggest innovative development of this decade and will become indispensable for all market operators in the near future.

* The future meter can communicate the user’s data via Internet, E-mail, SMS, etc. directly rather than having the central system acting as a liaison.
* The future meter can be used for demand purpose (stimulate the customer to change his energy behavior) and demand side management (direct control of household appliances such as washing machine, or the air conditioner).
* As the intricate details of the consumed units with regards to the time of usage are available through the meter, the operator can implement variable tariff rates, as well as notify the user about the same.
* Monthly bills can be made available via internet and each user will have a unique ID where he can gain information about his till-date consumption.
* The energy operator can provide prepaid services to the user where only a certain units of energy are allotted to a subscriber depending upon his/her prepaid amount.

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