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ARM Based Automatic Meter Reading and Centralized Control System

[1] Santosh Kumar N [2] Chaithanya V [3] Abhishek R [4] Archana S [5] K Raja Prashanth
[1] Assistant Professor [2][3][4][5] Student
[1][2][3][4][5] Department of ECE Sri Sairam College of Engineering, Anekal, Bengaluru -562 106

Abstract: **- Electronic energy meter is capable of taking readings and can store it into its memory. Taking energy meter reading is time consuming and an expensive task. The meter reader travels for a long distance and take the reading manually to prepare the bill. Consumers have to go to the billing office, stand in a long line and submit the bill. This is a boring job and time consuming also. It can be avoided by remote monitoring of electronic energy meter and prepaid billing system by the use of cash card. In this paper measurement of energy, remote monitoring, preparing of bill and billing system is presented. Low cost ATMEGA8L microcontroller is used here to control the whole system.**

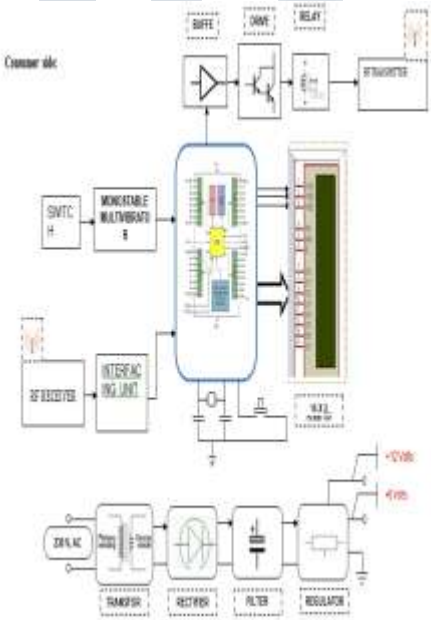
I. INTRODUCTION

The Automation of Public Service Sectors is the current trend, which transforms the manpower oriented services to semi-automatic or full automatic Sectors. As the country is opened to globalization, people's income is rising. And the Busy word is now become essential part of everybody's life. So, governments prefer not only to give quality service but also the corrupt & error free services to his citizens. As a result, this project proposed here is an advanced system, which helps Electricity Boards or Electricity Corporations to handle the Billing system smoothly. This project helps them to give quality service to its customer without any kind of problems. Traditionally, energy monitoring has been done through electromechanical energy meters installed on various feeders and loads. This present system is not to the expected satisfaction of the energy supplying authorities. It has many drawbacks:

1. We get only the raw data.
2. With available man power, as per the records, it is not possible to prepare error free bills.
3. In the existing system, the billing for amount of energy consumed in different areas of given city like Belgaum or Bangalore is difficult.

Modern technologies can offer much more elegant and cost effective solution to this need. Recording of energy consumption data through current pulses is simplest and cheapest arrangement. This project is aimed at developing system for accurate reading and billing from a computer at Main Power Transmission And Maintains Office with data communication through transmission line.

II. BLOCK DIAGRAM



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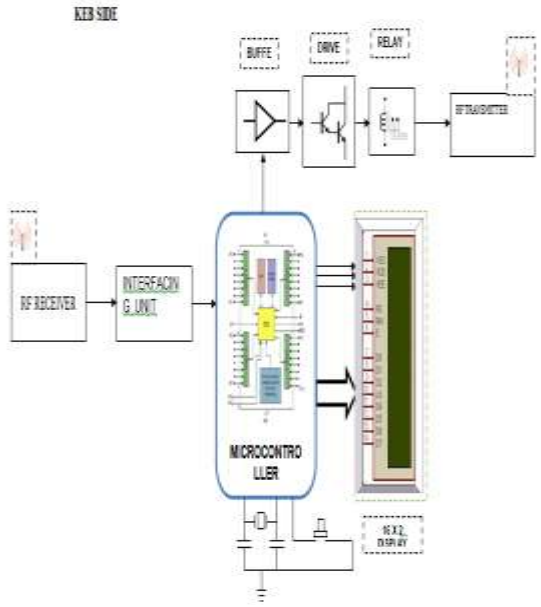

III. POWER SUPPLY UNIT

This section needs two voltages viz., +12 V & +5 V, as working voltages. Hence specially designed power supply is constructed to get regulated power supplies.

Switch

In electrical engineering, a **switch** is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another.

Microcontroller

The 89C51 Micro-controller is heart of this project. It is the chip that processes the User Data and executes the same. The software inherited in this chip manipulates the data and sends the result for visual display.The general definition of a microcontroller is ***a*** single chip computer, which refers to the fact that they contain all of the functional sections (CPU, RAM, ROM, I/O, ports and timers) of a traditionally defined computer on a single integrated circuit. Some experts even describe them as special purpose computers with several qualifying distinctions that separate them from other computers.

RF transmitter

This is 2-channel Radio Frequency Transmitter specially tuned with its RF Receiver part in carrier frequency. Each zone are set with one channel and transmits their presence to moving vehicle's RF Receiver unit.

RF receiver

This is also a 2-channel RF Receiver specially tuned with its counter part RF Transmitter in carrier frequency. When vehicle enters into any zone that zones RF signals are received by this unit. Thus depend upon the channel signals it receives from transmitting end that channel output of RF Receiver goes HIGH. This HIGH signal is fed to controller chip through Buffer & Driver and Switching stage for further processing.

Buffers

Buffers do not affect the logical state of a digital signal (i.e. a logic 1 input results in a logic 1 output whereas logic 0 input results in a logic 0 output). Buffers are normally used to provide extra current drive at the output but can also be used to regularize the logic present at an interface.

IV. METHODOLOGY

The section explains how the 'CENTRALIZED ELECTRICAL BILLING' really works. The project is mainly divided into two sections: Power Authority Side and Consumer Side.

Power authority side:

This Power Authority Side section, as name itself implies, is situated at the Power Transmission and Maintains Department's main office. This section is kept in the Main Office of the Power Transmission and Maintains Department, where all consumers Electricity Bill were prepared. The PC or Computer is activated on every month on particular day to collect the information of total units consumed by every consumer within that month. The activation of Computer in result triggers the RF Transmitter, which sends the activation signal to Consumer Side Section of every consumer in one-by-one fashion. And when the Consumer Side Section gets activated and starts emitting the information packets [which contains total units consumed by that consumer], this section receives them and proceeds that information packets to Computer for further processing. The activation signal is sent to Consumer Side Section using RF Signals and Information packets are transmitted using radio signals. The implementation of two entirely different communication techniques is to prevent any false triggering and to avoid interference of signals. The Software Module takes care of the data it received and printer prints the concerned consumers Monthly Electricity Bill depends on that received data. The Power supply Unit provides the necessary supply voltages to this Section.

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Consumer side

This Consumer Side Section is fitted with every Energy Meter used in that covering area, in which the Main Power Transmission and Maintains Office is situated. This section has two parts based on the activation mode: RF Receiver, which is always ON or in Active Mode and ready to receive the Activation Signal from Power Authority Side Section; and rest of the Blocks which are initially in sleep mode and gets activated only when RF Receiver gets Activation Signal. After activation, it sends the total number of units consumed by that Consumer in the form of RF Information Signals to Power Authority Side Section. Here one point is to be noted that even though rest of circuit is in sleep mode, it continuously tracks Energy Meter and keeps the number of units consumed in its memory. When this section gets activated this stored data is transmitted to Power Authority Side.

V. CIRCIUT DIAGRAM EXPLANATION POWER SUPPLY UNIT

The circuit needs two different voltages, +5V & +12V, to work. These dual voltages are supplied by this specially designed power supply.

1. Step-down Transformer

The conventional supply, which is generally available to the user, is 230V AC. It is necessary to step down the mains supply to the desired level. This is achieved by using suitably rated step-down transformer. While designing the power supply, it is necessary to go for little higher rating transformer than the required one. The reason for this is, for proper working of the regulator IC (say KIA 7805) it needs at least 2.5V more than the expected output voltage.

2. Rectifier stage

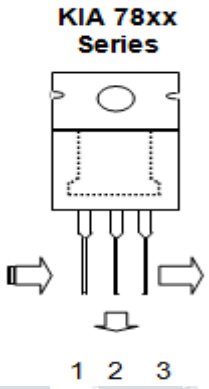
Then the step-downed Alternating Current is converted into Direct Current. This rectification is achieved by using passive components such as diodes. If the power supply is designed for low voltage/current drawing loads/circuits (say +5V), it is sufficient to employ full-wave rectifier with centre-tap transformer as a power source. While choosing the diodes the PIV rating is taken into consideration.

3. Filter stage

But this rectified output contains some percentage of superimposed a.c. ripples. So to filter these a.c. components filter stage is built around the rectifier stage. The cheap, reliable, simple and effective filtering for low current drawing loads (say upto 50 mA) is done by using shunt capacitors. This electrolytic capacitor has polarities, take care while connecting the circuit.

4. Voltage Regulation

The filtered d.c. output is not stable. It varies in accordance with the fluctuations in mains supply or varying load current. This variation of load current is observed due to voltage drop in transformer windings, rectifier and filter circuit. These variations in d.c. output voltage may cause inaccurate or erratic operation or even malfunctioning of many electronic circuits. For example, the circuit boards which are implanted by CMOS or TTL ICs.



The stabilization of d.c. output is achieved by using the three terminal voltage regulator IC. This regulator IC comes in two flavors: 78xx for positive voltage output and 79xx for negative voltage output. For example 7805 gives +5V output and 7905 gives -5V stabilized output. These regulator ICs have in-built short-circuit protection and auto-thermal cutout provisions. If the load current is very high the IC needs 'heat sink' to dissipate the internally generated power

Circuit Description

A d.c. power supply which maintains the output voltage constant irrespective of a.c. mains fluctuations or load variations is known as regulated d.c. power supply. It is also referred as full-wave regulated power supply as it uses four diodes in bridge fashion with the transformer. This laboratory power supply offers excellent line and load regulation and output voltages of +5V & +12 V at output currents up to one amp.

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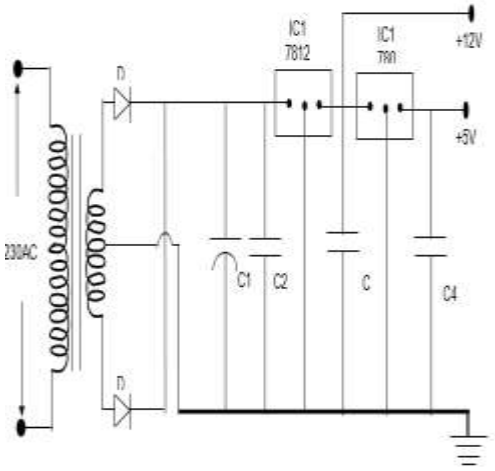
VI. CIRCUIT DIAGRAM OF +5V & +12V FULL WAVE REGULATED POWER SUPPLY

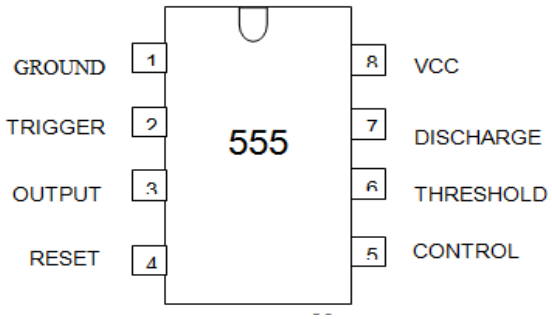


MONOSTABLE MULTIVIBRATOR

The timer comprises two operational amplifiers (used as comparators) together with an RS Bistable element. In addition, an inverting output buffer is incorporated so that a considerable current can be sourced or sunk to/from a load. A single transistor switch, TR1, is also provided as a means of rapidly discharging the external timing capacitor.

The standard 555 timer is housed in an 8-pin DIL package and operates from supply rail voltages of between 4.5V and 15V. This encompasses the normal range for TTL devices and thus the device is ideally suited for use in conjunction with TTL circuitry.

PIN DIAGRAM OF TIMER IC 555



VII. CIRCUIT DIAGRAM OF 555 MONOSTABLE MULTIVIBRATORS

The current through Constable Multivibrator will depend upon the light intensity falling on LDR sensor. In full fall the reverse current flowing through Light Detector will be very small. When the LDR has no light source falling on it, the capacitor C2 is uncharged and the trigger input is low and that switching transistor TR1 (at pin-7) is in the non-conducting state. Thus the output (at pin-3) is high. The capacitor C1 will begin to charge toward +Vcc with current supplied by means of the series resistors R1 and R2.When LDR senses light on its surface, the reverse current flowing through Light Detector increases markedly. Thus Monostable timing period is initiated by a falling edge (i.e. 'High' to 'Low' transition) applied to the trigger input (at pin 2). When such an edge is received and the 'trigger' input voltage falls below ⅓ of Vcc, the output of the lower comparator goes 'high' and the Bistable is placed in the 'set' state. The Q output of the Bistable then goes low, switching transistor TR_1 is placed in the 'OFF' (non-conducting) state and the final 'output' (at pin-3) goes High. The circuit can be readily adapted to drive a load with operating current less than about 150mA. So, the indicator LED (D1) goes 'ON' stating the relay is in ON position.

VIII. CONCLUSION

By using this embedded system along with GSM module, provide automation for electrical distribution system. Along with this , it provides better accuracy in meter reading , better control over distribution & management. Same system can be expanded for multipurpose like water and natural gas. Also many users can share same system.

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