Hardware Implementation of Prepaid Power Consumption Using Coin Box System

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Abstract. For enhancement of technology our implemented system is helpful for the human beings for in this world. Basically in guest house, lodges, hotels and rest houses the power consumption is not measurable by the customer and the owner. So that it is important to control the consumption of power proportional to the payment otherwise the owner pays the higher bills and faces the loss in running the hotel. For we develop the pre-paid system for power consumption by using some simple discreet components and microcontroller programmed for desired output. Using highly advanced ICs and with the help of growing technology the proposed hardware has been successfully implemented but by using pre-paid card in place of token/coin we can make a more advanced system. Moreover, this system, for enhancing the requirement the technology the system can be replaced with GSM (Global System for Mobile Communication) Modems, it will help the tracking of the consumers load on a regular basis is possible, it help in the maximum demand for tracking, more over instead of recharging the chip has be detected through online theft, the readily used in cell phones available recharge cards (smart cards can be introduced. Using with given mechanisms, consumers much user friendly for recharging their meters and at their convenience.

Keywords: Coin Sensor, Display Device, Dual Timer, GSM Modems, Microcontroller (AT89C2051), Relay, Trigger Circuit.

1. Introduction
The automatic coin collection device can be built with the on the lines of pay phone, for various load like air conditioners, lamps and many electrical equipment to be required for a private electrical line. In this process the prepaid card meter in the energy meter has be inserted. If the card comes to an end, electricity supply is cut off by the help of relay [1-3]. The system make use of a sensor LDR and a light source for detecting the token/coin, coin interrupt the beam of light for a second to generate a pulse which is detected by the IC 1 at the pin number 6 and feed to the microcontroller which displays the number of counts in the form of pulses by using seven segment decoding IC 3 in digit form. we close the load switch S2 it trigger the transistor T2 and operate the relay and supply the power to the room at the same time the number of counts starts
decreasing and when reached to zero to disconnects the power supply. So this is the cheapest and the best system. It is useful for many different places like as guest houses, lodges, trains and another various palaces [8-9]. The system makes uses of coin of a sensor for detecting the coin and the microcontroller that counts the coin and shows the count on a 7 segment display. This comprises the microcontroller AT89C2051 (IC2), dual timer NE556 (IC1), 7 segment decoder, CD4511 (IC 3), regulators and a few discrete components. Here microcontroller is the heart of the circuit to operate the complete operation of the system. When load is connected switch is closed, the relay used in hardware will energize the power transmitted the load and across the hardware display count has decreasing the count value as per used power across the load. If the decremented count value is zero. The relay switch is de-energized and load is disconnected with power supply. This system is made from simply available discrete components. This can be used for 5 watt to 15 watt power supplies and thus is suitable for hotels, lodges, guest house, and public services such as cyber café, music stations, and automatic mobile charging points. It makes use of less power consumption and is cost effective. This comprises the microcontroller AT89C2051 (IC2), dual timer NE556 (IC1), 7 segment decoder, CD4511 (IC 3) and a few discrete components. LED1 is used as the light source for the light dependent resistor LDR1, which is made of cadmium sulphide and acts as the coin detector. Resistor R1 limits the current through LED1. The light from LED1 falls continuously on LDR1, whose resistance decreases with increase in the incident light intensity. LDR1, connected at trigger pin 6 of IC1, offers low resistance when light is falling on it and its trigger input goes low to set the flip flop and make output pin 5 of IC1 High. Fig.1 Indicate the block diagram of the invented hardware system.

2. Components of the implemented hardware system

2.1. Microcontroller (at89c2051)
In automatic system microcontroller is the heart of the Implemented hardware system. The used microcontroller in our system is a low-voltage, high-performance CMOS 8-bit microcomputer with erasable read-only memory (PEROM) and 2K bytes of Flash programmable memory.

2.2. Pull Up Resistors
In hardware system function of pull-up resistor connected between a positive power supply voltage and conductor to ensure that the supply signal will be a valid logic level, if introduced for high impedance the external device are disconnected. it also be used with different power supply voltages and possibly operating at different logic level. It pulls the voltage of the given signal and connected to towards its voltage source level required. When the other devices are connected with the signal are inactive, the signal the voltage supplied by the pull up prevails and brings the given signal up to a logical high level. If other device on the line goes enable, it overrides the

Fig. 1 Block Diagram for Prepaid Energy Meter Using Coin
pull-up resistor. It ensures that the wire is at a defined logic level even if no enable components are connected to it.

![Pull up resistors connected to the logic circuit.](image)

**Fig. 2** Pull up resistors connected to the logic circuit.

### 2.3. FILTER

In our implemented system the work of low-pass filter that passes signals with a frequency lower than a certain cut off frequency and attenuates signals with frequencies higher than the cutoff frequency. Attenuation of frequency depends on the design of the filter. This type of filter is also called a high-cut filter, or treble cut filter in audio applications. It is available in different forms in electronic circuits for using in different application such as anti-aliasing filters for conditioning signals prior to analog to digital conversion, digital filters for smoothing sets of data, acoustic barriers, blurring of images, and so on. It is used to provide a smoother form of a signal, removing the short-term fluctuations, and leaving the longer-term trend.

![Circuit for Low pass filter](image)

**Fig. 3** Circuit for Low pass filter

### 2.4. REGULATOR- LM78XX

The LM78XX (Voltage Regulator) are the three terminal regulators is present in various fixed output voltages and used in a large range of applications. it is available in an aluminium TO-3 package it allow 1 amp. current as adequate heat sinking is present. by using we can minimize the number of components. it also improve the transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply. if the voltage output other than 5V, 12V and 15V then we can use LM117series provides an output voltage range from 1.2V to 57V.
2.5. Sensing unit
The system makes use of a sensing unit that consists of LDR (light dependent resistor) which senses light from a LED (light emitting diode). This combination detects the coin, used as a token here. As soon as the coin passes through a thin passage provided between the LED and LDR, the light from LED falling on the LDR gets blocked. The coin or token after passing falls into the coin container, a hard paper box. The blockage of light or the dark is sensed by the LDR and it sends a signal to the dual precision timer. Each time the coin passes, a signal is sent to the timer, which in turn senses that signal and generates a pulse. This pulse is thereby sent to the microcontroller. Microcontroller hence counts the pulses and token value is sensed and stored in the microcontroller. The number of count of coin is displayed on a seven segment display with the help of a 7 segment decoder which acts as an interface between microcontroller and the display.

2.6. LIGHT DETECTING RESISTOR
The LDR is a light sensing device which significantly receives light and on the contrast works correspondingly by adjusting its resistance. Usually the resistance of the LDR is very high as of order 1Mohms. When the light falls on the LDR, the LDR conducts electric current which is the result of reduce in the resistance of the LDR. In sufficient intensity of light the LDR conducts and the sensitivity of the LDR can be set appreciable by using a sensitivity controller.

![Fig. 4 Symbol of LDR Circuit](image)

2.7. SENSITIVITY CONTROLLER
It is a device used for controlling the sensitivity of light dependent resistor. Its knob can be adjusted so as to vary the sensitivity of the LDR. It can also set to any value within its range of its intensity. The knob of the sensitivity controller maybe set to its minimum value for low intensity of light and correspondingly to its maximum value in case of high brightness or in the zone of high light intensity.

2.8. DUAL PRECISION TIMER
One of the important components of the implemented hardware system is the timing circuit, in these we are using two timer circuit NE555 or SE555 type in every package. It is operated in mono-stable or bi astable mode with using external resistor-capacitor (RC) for timing control. The timing has provided with the help of RC components, it has controlling with the bias control voltage input. Here two third levels are threshold and triggering level and one third of VCC. His work is if triggering input lower than triggering level then flip flop is set and output goes high. If it above then flip flop is go reset and output go low. If output is low, a less impedance path is provided between the ground and discharge terminal.
3. Flow Chart to Operate the Implemented Hardware System

START

INITIALISE THE REGISTER

Is Coin Count = 0?

DEENERGISE RELAY

TIME ON?

Is Power ON?

YES

EMERGENCY RELAY

DECREMENT r3 BY 1

DELAY FOR 2 SECOND

MONOSTABLE START TIMER

COIN SENSED

INCREMENT r3 BY 5

INDICATE COIN SENSED ON LED

NO

NO

NO

YES

YES

NO

NO

YES

Fig. 5 Block Diagram for Dual Precision Timer
The circuit diagram shows put coin and draw power circuit. It comprises the microcontroller AT89C2051 (IC2), dual timer NE556 (IC1), 7 segment decoder, CD4511 (IC3), regulators 7805 & 7806 (IC4 IC5) and a few discrete components. LED1 is used as the light source for the light dependent resistor LDR1, which is made of cadmium sulphide and acts as the coin detector. Resistor R1 limits the current through LED1. The light from LED1 falls continuously on LDR1, whose resistance decreases with increase in the incident light intensity.

The NE556 dual monolithic timing circuit is a highly stable controller capable of producing accurate time delays. It’s basically a dual NE555 in the time delay mode of operation. The time is precisely controlled by external capacitor and resistor. The two timers operate independently of each other sharing only Vcc and ground. The circuits may be triggered and reset on falling waveforms. One timer of NE556 is used for coin detection. LDR1, connected at trigger pin 6 of IC1, offers low resistance when light is falling on it and its trigger input goes low to set the flip flop and make output pin 5 of IC1 High. The coin has to be put up. It interrupts the light falling on LDR1 and trigger pin 6 IC1 goes high to make pin 5 output goes low. By the given process of high to low pulse counting process will be start by the help of microcontroller. Microcontroller is the heart of the circuit. A five vector 2 levels interrupt architecture, a full duplex serial port, a precision analog comparator, on chip oscillator and clock circuitry. His crystal circuit provides the clock frequency. Output detected coin pin 5 of NE556 is connected with port pin P3.0 of the microcontroller (IC2). The microcontroller indicates the counted value on 7 segment display. [11-13]

Coin detection can also indicate through LED2 which is connected to pin P3.7 of the microcontroller. After putting the coins close switch S2. Port pin P1.1 of the controller goes high to drive the transistor T2 to saturation level. The Relay RL1 glows the LED 3 to indicate that the load is now switched ON. Here freewheeling diode is work with D1.

4. Hardware Construction and Result Analysis

An actual size single side PCB for the put-coin-and-draw-power circuit and the circuit on the PCB and check for the proper connections using multi-meter [7-9].

![Fig. 6 Complete Circuit Diagram for Implemented Hardware System](image-url)
Take a 10cm, hollow rectangular cuboids of plastic in which the coin can be inserted easily. Drill holes on its opposite sides at the center and fix LED1 and LDR1 such that these are placed face to face. Align LED1 and LDR1 such that light from LED1 falls on LDR1 directly. Cover the coin collection assembly to maintain the darkness, leaving only the coin insertion and coin release holes open. Extend LED1 and LDR1 from the PCB to the coin assembly using wires. When a coin is inserted into coin collection assembly, the light falling on the LDR is blocked as the coin comes in between LED1 and LDR1. LDR1 offers high resistance in the absence of light and this is detected by one timer of NE556 and indicated by LED2. We can insert up to 9 coins and this count is displayed on DIS1. When you close the load switch S2, the relay Energies and the load turns ON. The count displayed on DIS1 starts decrementing after LED4 blinks 4 times. The relay de-energies to turn the load OFF when the count displayed on DIS1 becomes zero. Load-'ON’ duration can be adjusted using preset VR1. Never insert the coin without pressing reset switch S1.

![Fig.7](image)

(a) Components’ of all implemented hardware system
(b) Complete hardware system with load

5. CONCLUSION

Our implemented hardware system uses a sensor for detecting the coin or token. Microcontroller counts the number of coins/token and shows the count on a seven segment display. When load switch is closed the relay connects the load and the coin count on display, starts decrementing. The count decrement to zero the relay de-energies to disconnects the load. This system is easy to Install and also cost effective which a major advantage is. This system has a less power consumption it uses 5Watt to 15Watt power supply. Any metal token can be used in this system. It is suitable for hotels, lodges, trains, guest houses, Public services such as cyber café, automatic mobile charging stations, etc. The working unit indication is accurately indicated by this implemented hardware system with use of advanced IC’s has included to help the enhancement of present implemented system. Thus, this system provides a prepaid system for supplying the power wherever needed. The proposed invention has solved the difficulties and extra burden for electricity billing and save time and money for consumer and electricity departments. Moreover, this system can also enhance with the GSM Modems, for tracking of the consumer load on regularly. It has work with internet with maximum demand and supply of the customer, customer
used in cell phone for recharging the meter. This invention will be user friendly in now current scenario.

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