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Design and Development of Low Cost Security Alarm Using Optoelectronic Device

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Abstract: *Nowadays security has become a major concern in our modern world due to the high rate of robbery, thief etc. in many important places such as home, museum, office, and other business places. Due to the importance of security in our lives as humans, this research work aims at designing a security system that could be used in home, museum, office, and other business places as well. The designed security system is simple, effective and cheap. An oscillator circuit is designed to produce a desired frequency and a photo transistor is used as a sensor. This sensor spreads the frequency around a certain area. When unauthorized entry occurs in this area the frequency detects it. Then the sensor passes a signal to a speaker through certain amplifiers and then the speaker produces sound. This security system is operated by an external power supply. An additional power supply (a battery) is used as an alternative power supply. When there is no external power supply, the security system is operated by this additional power supply.*

Keywords: *Security system, oscillator circuit, photo transistor, sensor and power supply.*

I. Introduction

A security alarm is a system designed to detect intrusion – unauthorized entry – into a building or area. Security alarms are used in residential, commercial, industrial, and military properties for protection against burglary (theft) or property damage, as well as personal protection against intruders. Car alarms likewise protect vehicles and their contents. Prisons also use security systems for control of inmates [1]. Some alarm systems serve a single purpose of burglary protection; combination systems provide both fire and intrusion protection. Intrusion alarm systems may also be combined with closed-circuit television surveillance systems to automatically record the activities of intruders, and may interface to access control systems for electrically locked doors. Systems range from small, self-contained noisemakers, to complicated, multi-area systems with computer monitoring and control.

The most basic alarm consists of one or more sensors to detect intruders, and an alerting device to indicate the intrusion. However, a typical premises security alarm employs the various components, namely: Premises control unit (PCU), Alarm Control Panel (ACP), or simply panel, Sensors [2], Alerting devices, Interconnections, Security devices, etc. In addition to the system itself, security alarms are often coupled with a monitoring service. In the event of an alarm, the premises control unit contacts a central monitoring station. Operators at the station see the signal and take appropriate action, such as contacting property owners, notifying police, or dispatching private security forces. Such signals may be transmitted via dedicated alarm circuits, telephone lines, or Internet.

C. K. Ng [3] et al has developed a wireless security system where an alarm system isprogrammed in a graphical user interface (GUI).The system is used to monitor the RFID reader, RFID tag and the GSM terminal. The information obtained from the tag is sent to the server in a RF link that is exhibited in a G UI. If the laptop is stolen from the stopped until the laptop is put back in the covered region, or the program is cove re d region, the alarm system will start to draw attention. Meanwhile, the laptop owner willbe notified by an alert message. In addition, the alarm system will not be stopped until the laptop is put back in the covered region, or the program is stopped/terminated. RFID have been available for many years for reading bar c odes RFID tag located several meters away [4-7]. It is increasingly being used in other applications ranging from inventory management to anti-counterfeiting protection. GUI [8] is used in a vehicle security system where the information is controlled via the GUI. The system is activated when the tag is read while the motorcycle is being located within the effective range.

The aim of this project is to design an electronic device in order to minimize the high rate of criminal activities in our homes and industries.

II. Design And Circuit Description

The complete circuit diagram of the designed IPS is shown in Fig. 2. The descriptions of each part are furnished below:

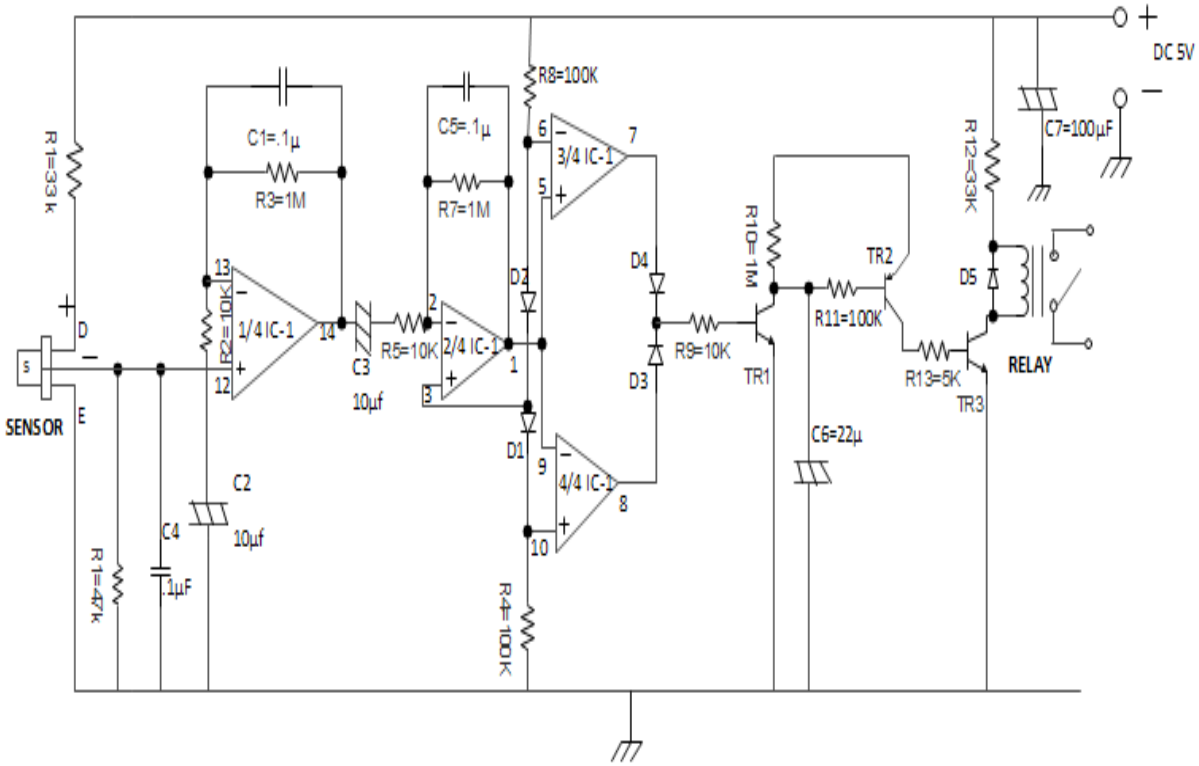

Fig. 1: Complete circuit diagram of the security alarm.

2.1 Transformer

A transformer is an electronic device that transfers electrical energy from one circuit to another through inductively coupled conductors known as the transformer's coils. A transformer has a primary coil and a secondary coil. It transfers or induces AC electrical power from its primary winding to its secondary winding. The DC power can never be transferred within the windings. The DC power is first converted into AC power and then transferred by it. A varying current is applied in the first or primary winding that creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF), or "voltage", in the secondary coil. The size of a transformer ranges from small unit weighing a few gm like a coupling transformer hidden inside a stage microphone to huge units weighing hundreds of tons used to interconnect portions of power grids. All operate with the same basic principles [9].

2.2 Power supply and charger circuit

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. All power supplies have a power input, which receives energy from the energy source, and a power output that delivers energy to the load. In most power supplies the power input and output consist of electrical connectors or hardwired circuit connections, though some power supplies employ wireless energy transfer in lieu of galvanic connections for the power input or output. Some power supplies have other types of inputs and outputs as well, for functions such as external monitoring and control [10]. The power supply is a combination of three sections [11-13], namely: bridge rectifier, a capacitor filter and IC voltage regulator. Fig. 2 shows the designed low voltage power supply and the charger circuit.

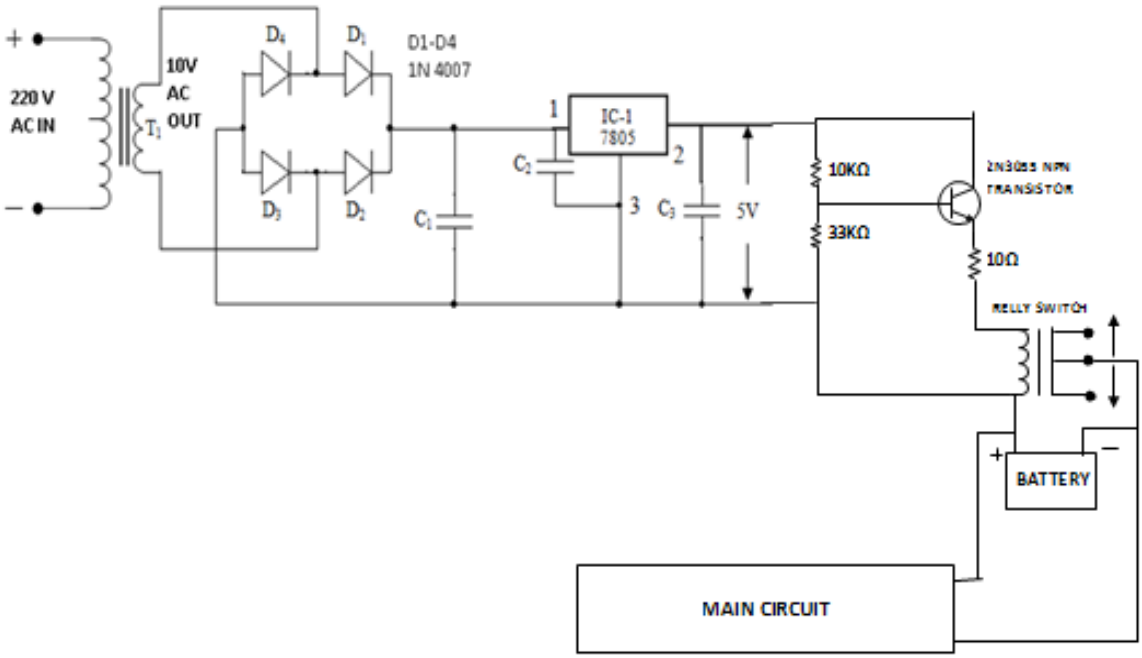

Fig. 2: Schematic diagram of low voltage regulated power supply and charger circuit.

2.2.1 Bridge rectifier: The bridge rectifier converts the step-down transformer's secondary ac voltage into pulsating dc voltage [9].

2.2.2. Capacitor filter: The pulsating dc voltage is applied to the capacitor filter. This filter circuit reduces the pulsations in the rectifier dc output voltage and the output voltage is 6V.

2.2.3 IC voltage regulator: The IC voltage regulator provides regulated output and C2 is used to improve transient response. Although voltage regulators can be designed using op-amp, it is quicker and easier to use IC voltage regulators [14]. In this design a positive fixed voltage regulator L7805 is used.

2.3 Battery

A battery is a device that converts chemical energy directly to electrical energy. It consists of a number of voltaic cells; each voltaic cell consists of two half cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the electrode to which anions migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cations migrate, i.e., the cathode or positive electrode. In the redox reaction that powers the battery, cations are reduced (electrons are added) at the cathode, while anions are oxidized (electrons are removed) at the anode. The electrodes do not touch each other but are electrically connected by the electrolyte. Some cells use two half-cells with different electrolytes. A separator between half cells allows ions to flow, but prevents mixing of the electrolytes [15].

2.4 The Oscillator Circuit

Generally, an electronic circuit that produces a repetitive electronic signal is known as an electronic oscillator. More precisely, an oscillator is a circuit that generates a repetitive wave form of fixed amplitude and frequency without any external input signal. Basically the function of an oscillator is to generate alternating current or voltage wave form. It often produces a sine wave or a square wave with adjustable frequency and voltage requiring no ac drive. In other words oscillators may be considered as an amplifier with infinite gain. They may also be treated as a dc to ac converter without any external input [16, 17]. Generally Oscillators are characterized by the frequency of their output signal. An audio oscillator produces frequencies in the audio range, about 16 Hz to 20 kHz. An RF oscillator produces signals in the radio frequency (RF) range of about 100 kHz to 100 GHz. A low-frequency oscillator (LFO) is an electronic oscillator that generates a frequency below ≈20 Hz. Oscillators that produce a high-power AC output from a DC supply are usually termed as inverters.

2.4 The Amplifier

An electronic amplifier, amplifier, or (informally) amp is an electronic device that increases the power of a signal. The amplifier is often described as the heart or the nervous system of a microphone or loudspeaker, the total amount of watts used by the amp is usually a 50 watt stereo [18]. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with a larger amplitude. In this sense, an amplifier modulates the output of the power supply to make the output signal stronger than the input signal. An amplifier is effectively the opposite of an attenuator: while an amplifier provides gain, an attenuator provides loss. The four basic types of electronic amplifiers are voltage amplifiers, current amplifiers, transconductance amplifiers, and transresistance amplifiers. A further distinction is whether the output is a linear or nonlinear representation of the input. Amplifiers can also be categorized by their physical placement in the signal chain [19].

2.5 The sensor

A photo-transistor is used here as a sensor which is also known as pyroelectric (PIR) sensor. This sensor uses infrared radiation to detect unauthorized entry [20].

III. Results And Discussion

The design of this work was planned in step-by-step and systematic way. At first the whole system was outlined in a block diagram and then the different parts of the circuits of the block was designed and tested. Finally the whole system of the designed system was developed and following data's have been obtained.

Transformer:

Primary Input: 220V, 50 Hz.

Secondary Output: 5V, 50 Hz.

Rectifier:

Input: 5V, AC

Output: 6.5V, DC

Voltage regulator:

Input: 6.5V, DC

Output: 5V, DC

The main reason for testing all the components before they were finally soldered on the breadboard is to avoid the painstaking effort it will take to dis-solder faulty components at the end of the day. From the continuity test carried out on the breadboard to check the circuit path, it was discovered that the circuit was in a perfect working condition as continuity was ensured. Simulation of the circuit design was also done as mentioned earlier, with the sole objective of comparing the results obtained from design calculations to that obtained from simulation. The two results when compared closely correspond with only a very slight discrepancy in values. Finally simple sound activated burglar alarm system has been designed, constructed and tested. It is suitable for indoor security especially in small rooms, artifacts in museums, jewelry stores, art galleries etc. This burglar alarm is thus very good for safe guarding valuables.

IV. Conclusion

It can be concluded that the sole aim of carrying out the design, analysis and implementation of a simple and reliable security system was achieved, in that the aim was to develop a cheap, affordable, reliable and efficient security system, which was successfully realized at the end of the design process. One factor that accounts for the cheapness of the product was the proper choice of components used. The ones that were readily available were used, while a close substitute was found for those that were not readily available. The reliability of the entire alarm system was considered by the integration of an automatic change over switch into the power supply unit such that the A.C mains supply and the battery are cold redundant. Thus, this guarantees constant supply of power to the main circuit. The efficiency of the entire system was put into consideration by the use of transistor in the common collector mode to couple the output of the circuit to the speaker. The system was tested and found to be working to specifications and predictions. Summarily, a cheap and reliable way of checking of activities of burglars and intruders has been successfully developed, which is the aim of the research. We can conclusively say therefore, that the benefits of having this burglar alarm system cannot be overemphasized.

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