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Photosensitive Security System for Theft Detection and Control using GSM technology

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***Abstract*— This paper illustrates the design and development of a theft control system for security lockers, homes, bank lockers, jewelry outlets, etc. The proposed system consists of an LDR (Light Dependent Resistor) based sensor which acts as an electronic eye for detecting the theft or attempt, and a signaling procedure based on SMS using GSM (Global Systems for Mobile communications) technology. The GSM based communication helps the owner and concerned authorities to take necessary and timely action in order to prevent the theft. The LDR circuit is interfaced using a relay circuit with an Arduino microcontroller board. Efficacy of the proposed system can be seen in its immediate intimation regarding the incident. The proposed designed system is very effective and inexpensive.**

Index Terms— **Arduino microcontroller, GSM 300 Module, LDR, Photosensitive, Security system.**

I. INTRODUCTION

In this modern era of automation, there is a need to keep things under control through the use of well-defined technology and engineering capabilities. Over the years, many engineering fields like computer science, electronics, communication and Instrumentation technology, use sensors together in order to get better products and benefits. Obviously, it is a convincing fact that interdisciplinary efforts would lead to success because each field would overcome the limitations of the other. So, taking this as a motivation, an attempt is made here to develop an alternative method to provide security. This ensures theft control design for bank locker systems and many other applications, by using LDR, GSM technology to send SMS, etc.

Most of the recent advancements in the field of security incorporate technologies like bar code [1], sensor networks[2], RFID [3] etc. Apart from the technologies, wide varieties of sensors are also being implemented like SHT 11 (Temperature and Humidity sensor) [2], proximity sensor [4] etc. The commonly used processors by the delegates of this field are FPGA [5], ARM [6], [11], and microcontrollers [5]. However, most of the present day theft control schemes are relying on face recognition [7] and TDMA. Although this provides power efficiency, this requires algorithms using image processing techniques. This has greatly increased the complexity and cost of implementation. Hence in view of an economical, compact system for security, this design is put forward. In this method, the LDR detects a change in the light intensity when the bank locker is open and it powers the Arduino board when high light intensity is present. The board is pre-programmed in such a way that it sends a message to the account holder and concerned officials through the GSM modem that is interfaced serially. This indicates that the locker is open. The LDR circuit that is attached to the inner side of the locker, immediately detects any slight glimmer of light entering from outside. The remaining circuit (Arduino and GSM) comes outside the locker and is invisible to the burglar as it lies behind the locker case.

II. PROPOSED SYSTEM

The block diagram comprises of the power supply section, Arduino UNO board, GSM SIM300 Module, LDR with relay circuit and MAX 232 driver. The relay circuit is powered through a step down transformer and the GSM modem using a 9-12 volts AC-to-DC adaptor. A valid SIM card with sufficient recharge amount must be inserted to the modem to make outgoing calls or messages.

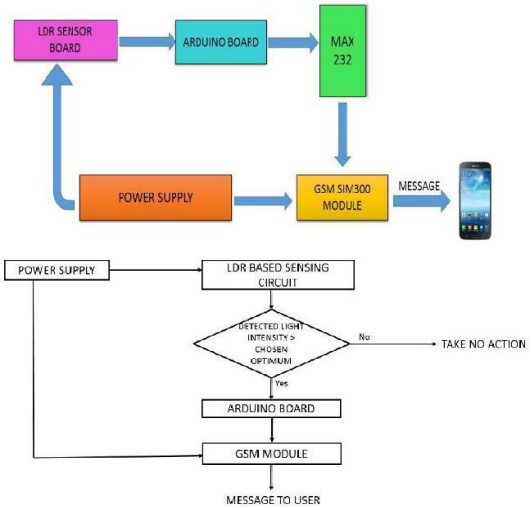

Fig. 1 Block Diagram and Work Flow Chart of process.

TABLE 1. (COMPARISON TABLE AS PER THE STANDARD DATA SHEET SPECIFICATIONS).

S. No.	Aspects (in terms of sensor used.)	Existing systems	Proposed system
1.	Cost	Cost of other sensors is more like solar cells, laser cells, etc.	LDR is a very cheap sensor
2.	Robustness and availability	Other sensors need packaging and availability depends on usage	LDR is robust and easily available in any market.
3.	Variance in application	Less	Many different kinds of LDRs exist which have strong sensing capability; multiple sensors can also be placed together.
4	Space occupied	Quite moderate	Less space because only a small circuit is used to activate the LDR
5	Sensitivity	Sensors sensitivity is not as high as LDR.	Sensitivity is very high, a faint glimmer of light can be easily detected by LDR(100 kilo ohms per deg.C)
6	Power source	Requires more power	Very less power in terms of few 100s of millivolts.
7.	Power dissipation	More	Very less up to 90mW/1 deg. C
8.	Operating temperature	Most sensors work at room temperature(narrow range)	Can withstand temperatures between -60 to +75 deg.C.
9.	Response time	0.1 to 0.8 sec. Other sensors.	LDR has rise time of 20ms and fall time of 30ms. Implies fats response like human eye.
10.	Max. Breakdown voltage	Sensors like photodiodes, photo transistors have less breakdown voltage.	Up to 150 volts.

A. LDR (Light Dependent Resistor):

The LDR is a resistor whose resistance varies inversely with the intensity of light incident on it. Its resistance can vary from 400 Ω (for 1000 lux light) to as high as 10^7 Ω (for 10 lux light). Therefore, even with a slight change in incident light intensity, there is a significant change in resistance, thus making the measurement reliable. It is provided on board to interface the board with the real world luminous intensity as the parameter. It is connected in the lower half of a potential divider configuration with a 10K ohm resistor, so that the resistor-LDR junction voltage is inversely proportional to the amount of light incident on it.

B. Relay:

The relay being used is a 230V / 2A relay and is an electromechanical relay. The excitation voltage required is +12V DC. It is driven using the relay driver IC ULN2003 /VLN 2003A. When the relay is excited by applying the 12V DC, it gets activated and in the process turns ON the device.

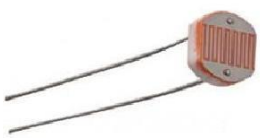

Fig. 2(a) LDR.

Fig. 2(b) Relay.

C. GSM SIM 300:

A GSM modem is a modem that provides a wireless communication. The device GSM SIM 300 used here is a dial-up modem. Unlike a normal dial-up modem, this GSM modem sends and receives data through radio waves. But a wired dial up modem sends and receives data through a fixed telephone line connected by wires or cables. One advantage of using this is that the complexity of wiring is reduced, connection is not disturbed by any physical interference, loss, etc.

D. Arduino Board:

Arduino is based on the ATmega328 microcontroller. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller and can be simply connected to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

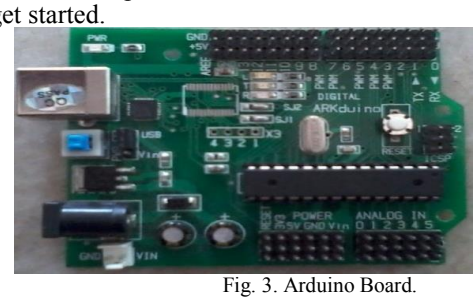

Fig. 3. Arduino Board.

II. CIRCUIT DESCRIPTION

A. Power Supply:

The circuit consists of a standard power supply comprising of a step-down transformer from 230V to 12V and 4 diodes forming a bridge rectifier. This delivers pulsating dc, which is then filtered by an electrolytic capacitor of about 470µF to 1000µF. Since the filtered dc is unregulated, IC LM7805 is used to get 5V DC constant at its pin number-3, irrespective of input DC varying from 7V to 15V. The dc voltage at the input of the regulator changes from about 8V to 15V, because of AC voltage variation from 160V to 270V. The regulator output will remain constant at 5V. The regulated 5V DC is further filtered by a small electrolytic capacitor of 10µF for any noise so generated by the circuit. One LED is connected to this 5V point in series with a current limiting resistor of 330Ω to the ground.

B. Circuit Diagram:

The entire circuitry can be described in three parts for the ease of understanding. The first part describes the LDR based circuit, the second about how the Arduino is interfaced with GSM modem, and the third tells about the interfacing of LDR circuit with the Arduino Board.

First Part: The LDR based circuit consists of IC CD4060, a binary ripple counter. A step-down transformer produces a voltage of 6V, and is connected to a push button. From the push button the supply voltage is given to CD4060 16th pin. The transistor is connected to a piezo buzzer. Emitter terminal is connected to one side supply of Relay, and other supply terminal is fed to cathode of diode 1N4001. The NC, NO, COM (Common) of relay are connected to a load and a negative terminal of transformer.

Second Part: The Arduino board is interfaced with GSM modem through MAX 232. The pin 0 (RX) and pin 1 (TX) of the Arduino board are connected to pin 9 (R2OUT) and pin 10 (T2IN) of MAX 232 driver.

Fig. 4. LDR Circuit.

The pins of MAX 232, 16(VCC- +5V) and 15(GND) are connected to 5V and GND pins respectively of Arduino. The GSM modem and MAX 232 is interfaced using RX, TX and ground to the pins 7(T2OUT), 8(R2IN) and GND (Ground) of MAX232. In this way, the Arduino board is interfaced with GSM. A simple program is written in Arduino IDE (Integrated Development Environment) Software for interfacing Arduino with GSM modem where the message is send to user once the Arduino gets activated.

Third Part: The relay's NC, NO and COM pins of LDR based circuit are interfaced with the Arduino board. So the Arduino board gets activated when the LDR senses a change in the light intensity.

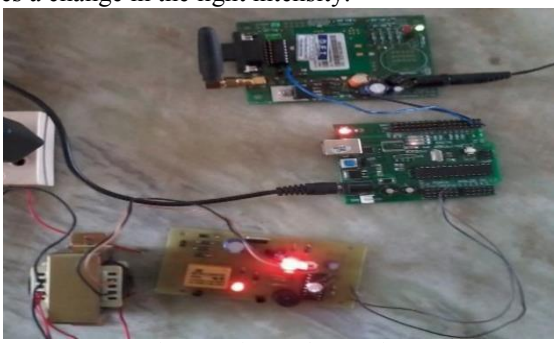

Fig. 5. Design Implementation.

III. SOFTWARE USED

The Arduino Integrated Development Environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the processing programming language and wiring projects. It is designed to introduce programming to artists unfamiliar with software development. It includes a code editor with features such as index highlighting, brace matching and automatic indentation. It is also capable of compiling and uploading programs to the board with a single click. Arduino programs are written in C or C++. The Arduino IDE comes with a software library called 'Wiring' from the original wiring project, which makes many input/ output operations much easier. User only need to define two functions to make a runnable cyclic executive program. As the Arduino platform uses Atmel microcontrollers, Atmel's development environment, AVR studio or the newer Atmel studio may also be used for the development of software for Arduino.

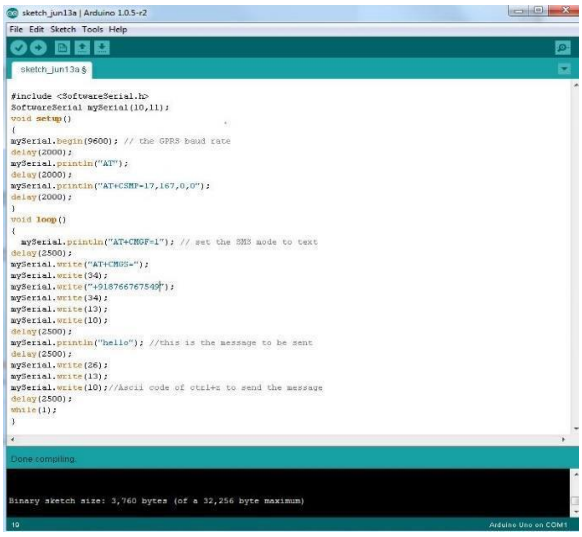

Fig. 6. Arduino Integrated Development Environment (IDE)

V. CONCLUSION

Theft control and security systems being a growing necessity in the present day scenario, this paper finds practical utility in real world situations. The feasibility of this proposed system is verified. The experiments and tests conducted have produced positive responses. This system is inexpensive and compact in size, thus overcoming many practical constraints. The maintenance and operational costs are also low. LDR is a widely available optical sensor.

The use of GSM technology assures to provide information to the owner as long as the person is connected to any GSM network and thus overcomes geographical limitations.

VI. FUTURE SCOPE

There are several ways in which the method proposed can be improvised at a greater length by using the modern security methods. For instance a high resolution camera can be used to take pictures of the person who has attempted a theft. Also data communications and networking is an upcoming field that can be exploited to achieve better performance in this area. For example, instead of GSM technology, a computer network (PC based) can be established to achieve efficient communication. Cybernetics and computer networks can be also used in order to quickly give information to the concerned authorities.

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