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Research Paper

Global System for Mobile Communication (GSM) Alert Electronic Eye Security System

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ABSTRACT:
The work is intended to discuss on GSM Alert on Electronic eye security system and testing. The significant parameters to ensure the safeguard of our household components are Home security and monitoring. The GSM alert Electronic eye may substantially ameliorate the safety mechanism of the living house. An incident of breach of security in the absence of the house owners is increasing day by day. In addition to the traditional security systems, there is a dire need fora state-of-the-art communication module with a microcontroller enabled system to send commands and receive alerts. The ultrasonic motion detector devices emit ultrasonic sound energy into an area of interest and this further reacts to a change in the reflected energy. The Doppler shift principle is the underlying method of operation, in which a change in frequency is detected due to object motion. The system uses a technique that is based on a frequency shift in reflected energy to detect a movement change in position. The wave is reflected from the surroundings in the room/hallway and the device hears a pitch characteristics of the protected environment. In this system, the wave pattern is disturbed and echoed back more quickly, thus concerning the pitch and signing an alarm whenever motion is detected. In this work, a transmitter transducer generates a signal at a frequency of 40 kHz, and when the signal is blocked by any moving object, and this, in turn, triggers a buzzer via a timing circuit. The electronic eye is designed to provide a securitysystem for home and offices. It is a simple, not so expensive, easy to use and reliable security system for room locker in homes, offices that support the use of a sensor and a microcontroller is used to send the signals to the control unit of the electronic eye. The Buzzer alarm is needed for on the spot security purposes.

KEYWORDS: *GSM module, Electronic Eye, Security, Alert system*

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I. INTRODUCTION

Security is a prime concern in our day-to-day life. Everyone wants to be as much secure as possible. In recent times the world has experienced an exponential increase in the rate of crime. Around the world, daily, criminals break into houses and commit all sort of crimes; carting with a huge amount of money and precious items. Sensitive and confidential documents, materials and equipment by the corporation are constantly declared missing from where they are kept. So there is a need to provide a device that can detect unauthorized persons in an environment [1].

The electronic eye is a type of burglar security system that automaticallyactivates a buzzer and sends a message to the household when a person visits your home. This alert system serves an awareness of persons in the environment and also provides security when any person attempts to enter the home premises without permission. The electronic eye continuously watches the premises persons attempting unauthorized entry into homes or a secure room that is preserved for some purpose [3]. An electronic eye uses various components to sense or receive signals from the surrounding such as, light-dependent resistor (LDR), motion sensor detector and ultrasonic sensor etc. which sense and then trigger a circuit, either turning ON/OFF a buzzer or sending a message to the household or security personnel that there is an intruder in the security area or room [3] [5].

The eye or ultrasonic sensor scan by sending out signals, which are sent back when they touch objects. The received signal is known as the echo signal and the object at which the transmitted signal hits is known as the target.The ultrasonic sensor sends signals at 40 kHz. The time taken for the sound wave emitted from the sensor to hit a target and reflect gives the range of the design security system of 2000cm. The range is made small for security purpose.By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sensor and the object [4].

II. RELATED WORKS

In [6], design and Construction of an Infrared Activated Security System at 9 kHz Frequency was done. This paper has reported the design procedure and construction of a security system to operate at an audible frequency of 9 kHz. The work offers assistance to our security personnel on guard to have thorough monitoring and control over the area of their operation. In [3], the design and construction of an Electronic Eye for Security System was carried out. The method used in this paper achieved the target to monitor the lockers in homes using the SMS-based system, Light-dependent resistor (LDR), Arduino satisfying the user needs and requirements. From the convenience of a simple cell phone, a user can monitor virtually the lockers in the house. The study produced more favourable findings to implement this kind of security support to home and banking systems.

In [5], the Electronic eye was designed and implementedfor Door image capture using a Microcontroller based security system for home and offices. It provides the user with an efficient and reliable security system for Door image capture for home, offices and industries that supports the use of a sensor at the door to send the signals to the control unit of the electronic eye with a buzzer alarm for security purpose with image capture as soon as the door opens with image capture at the output of laptop or PC with VB application. The system when routed through the IP address enables easy access to the appliances at home from distant locations [5]. Thus, the time delay inherent in-Home automation systems technologies that include Bluetooth, Zig bee and Z-wave uses remote control either through sending (SMS) are eliminated in IoT devices [2] [7].

III. MATERIALS AND METHOD

A. Materials

Some of the materials used in the design of the electronic eye securitysystem include, but not limited, the following:

I. Diodes
II. Resistors and Capacitors
III. Vero board
IV. Switches
V. Liquid crystal display
VI. Arduino Mini (ATmega328P)
VII. Buzzer
VIII. GSM module
IX. Light-emitting diodes
X. LM7805 (integrated circuit)
XI. Transformers
XII. Proteus version 7.8

B. Method

The circuit is divided into four sections as seen in Figure 1. Each section does a particular task. The four parts are the power supply unit, the input unit, the output unit, and the control unit. The block diagram shows the sections and the signal flow.

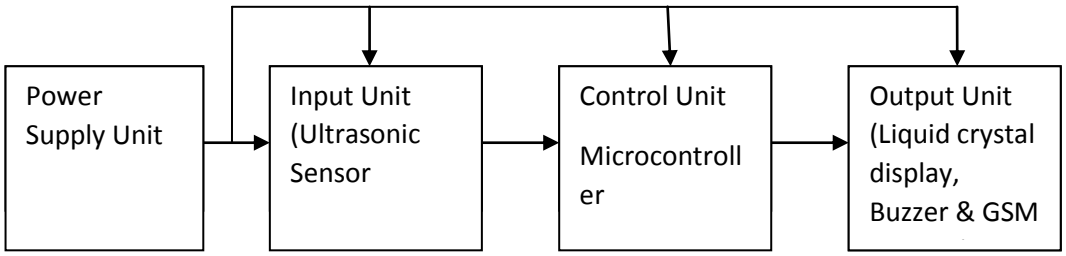

Figure 1: Block Diagram of the GSM Alert Electronic Eye Security System

a) Design Analysis

The circuit diagram shown in Figure 2 shows the main diagram of the electronic eye security system. The connection of different components required for the system to function properly. The four parts of the system will be explained below, namely: the power supply unit, the input unit, the control unit, and the output unit.

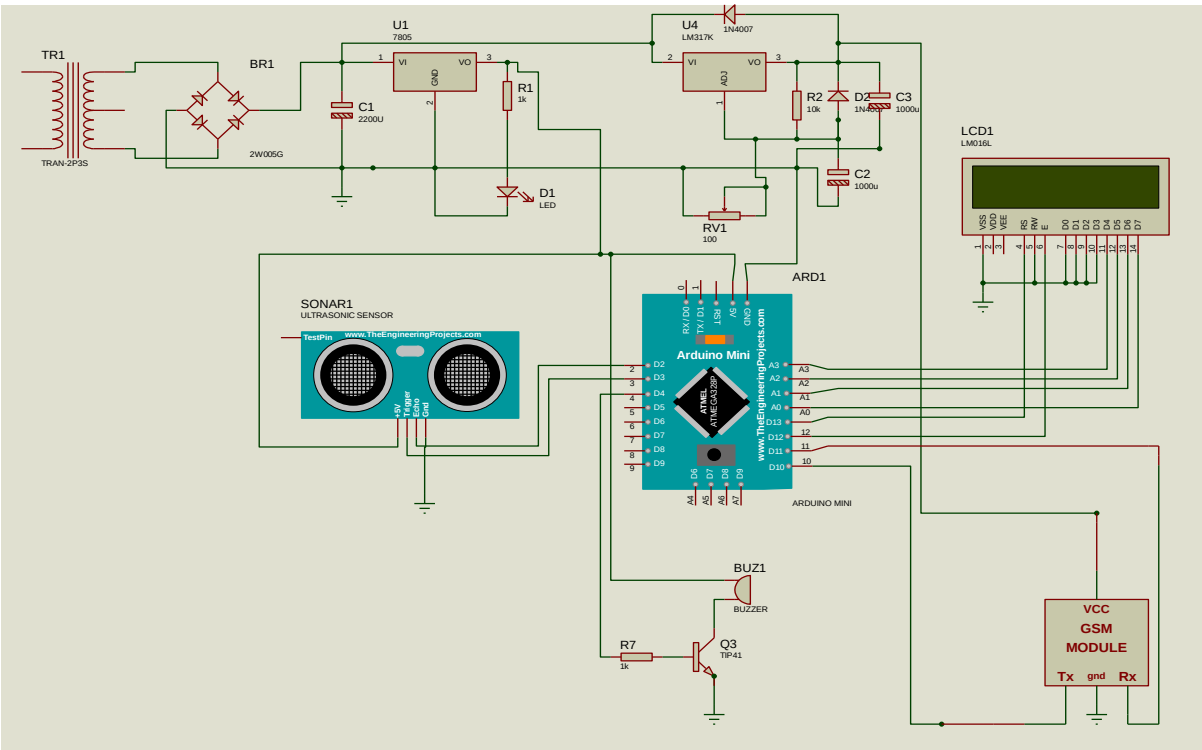

Figure 2: Circuit Diagram of the Electronic Eye Security System.

b)Power Supply Unit

The power supply unit is made up of the step-down transformer (TR1), which step down the 220V alternative current (a.c) from PHCN supply to 12Va.c. The 12Va.c is converted to 12V direct current (d.c) by a bridge rectifier (BR1). The d.c voltage gotten is filtered by using a filter capacitor (C1), the filter capacitor is used to filter off any ac ripples in the 12Vd.c voltage. The voltage from the filter capacitor is unregulated.Since, the voltage required by the circuit is 4.2Vd.c and 5Vd.c, voltage regulators were used to supply a constant voltage. The regulators 7805 (U1) supplies 5Vdc and LM317 (U4) supplies 4.2Vdc. A light-emitting diode (d1) is used as a power indicator. The circuit diagram of the power supply is shown in Figure 3.

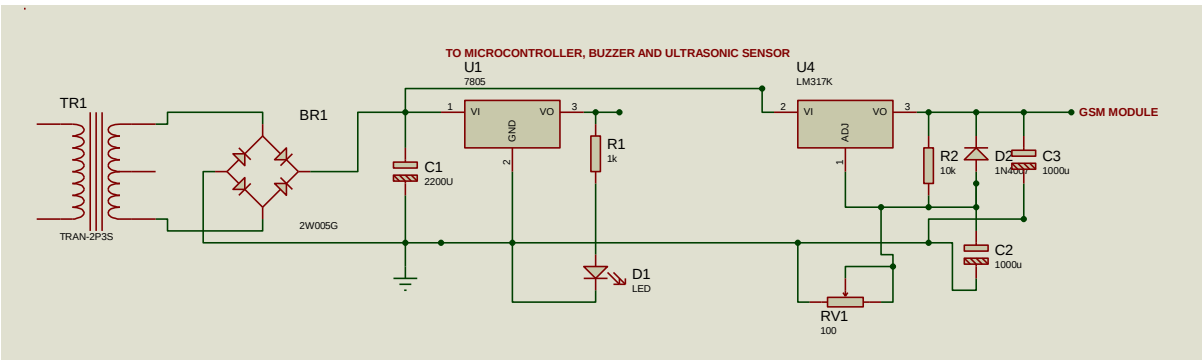

Figure 3: Circuit Diagram of the Power Supply Unit

c) Power Supply Calculation

The transformer used in the design is a 220Vac to a 12Vac transformer with a current capacitor of 2000mA. The voltage that is supplied to the transformer is 220Vac from the main supply; the voltage is step down to 12Vac.

$$V_m = \sqrt{2}V_{secondary} \quad (1)$$

V_m = The maximum voltage from the secondary of the transformer

V_s = The voltage from the secondary of the transformer

$V_m = \sqrt{2} \times 15 = 16.97\ volt$

The maximum peak voltage is 16.97 volt.

The average dc voltage gotten is calculated from the formula given in Equation 2.

$V_{dc} = 0.636V_m$ (2)
$V_{dc} =$ Average dc voltage
$V_m =$ Maximum Voltage of the Transformer
From equation 1, the maximum voltage is 16.97 volts.
$V_{dc} = 0.636 \times 16.97 = 10.79\ volts$
From the calculation, the average DC voltage is 10.79 volt. The bridge rectifier rectifies the voltage. The voltage gotten after the bridge rectifier is gotten from equation 3.

$$V_{dc} = V_m - 2(V_d) \quad (3)$$

$V_d =$ forward voltage drop across the silicon diodes $= 0.7$
$V_{dc} = V_m - 2(0.7) = 16.97 - 1.4 = 15.57\ volt$
The filter capacitor is used to filter off the ac ripples in the DC voltage, thereby reducing the ripple to a minimal level. The capacitor used in the design is 2200uf, the ripple voltage in the supply is gotten from the formula used in equation 4.

$$V_r = \frac{I_o}{2fC}; \quad (4)$$

$where;$
$f =$ frequency $= 50Hz$
$I_o =$ regulator output current,
$For\ C = 2200uf, I_o = 500mA$

$$V_r = \frac{0.5}{2 \times 50 \times 2200 \times 10^{-6}} = 2.27\ volts$$

From this the dc voltage after the filter capacitor is,
$V_{dcc} = V_{dc} - V_r = 15.57 - 2.27 = 13.3\ volt$
Three integrated chip voltage regulator is used to regulate the voltage from 13.3 volts to 5 volts and 4.2 volts.
From Figure 3, the light-emitting diode is connected in series to the limiting resistor. The limiting resistor reduces the current that that flows through the diode to prevent high current from flowing through the light-emitting diode. The formula used to calculate the current through the diode is gotten below,
From Kirchoff's voltage rule,
$V = V_r + V_d$ (5)
$V_d =$ Voltage drop across the light $-$ emitting diode
$V_r =$ Voltage drop across the resistor
$V = Total\ Voltage$
$V_r = I \times R, \quad V_d = 2\ volt, \quad V = 5$
Substituting this into the equation,
$5 = I \times 1000 + 2$
$5 - 2 = I \times 1000$
$3 = I \times 1000$

$$I = \frac{3}{1000} = 3\ mA$$

The current flowing through the light-emitting diode is 3mA.

d)Input Unit

The input unit is the electronic eye sensor, which is the HC-SR04 ultrasonic sensor. This is used to wirelessly measure the distance of an intruder from the sensor. It has four terminal devices: the pins-out are Vcc, Gnd, Echo, and trigger.The Vcc and the Gnd pin-outs is connected to the 5V and the Gnd of the voltage regulator respectively. The trigger pin is used to send a sound; this is triggered by sending a 10us signal to the trigger terminal from the control unit. The sound is reflected back from the intruder body. The distance of the intruder from the device is measured by the duration of the high-level times. Equation 6 is used to calculate the distance where velocity is 340m/s.

$$\mathbf{distance} = \mathbf{duration\ of\ highlevel} \times \frac{\mathbf{velocity}}{\mathbf{2}} \quad (6)$$

The duration of the high level is at the echoing terminal connected to the control unit. This signal is received by the control unit. The electronic eye is shown in figure 4

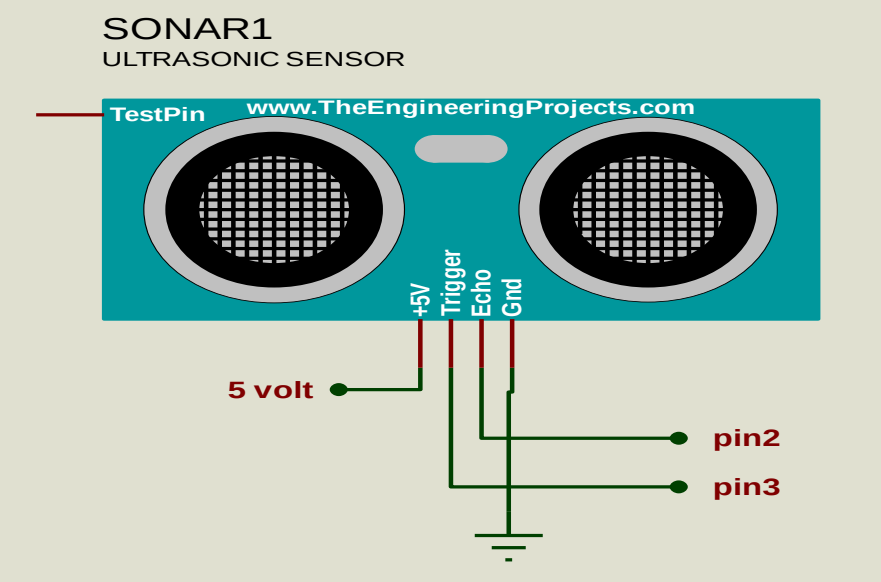

Figure 4: Circuit Diagram of the Input Unit

e) Control Unit

The control unit is a microcontroller. It is connected to the input unit, the power supply unit and the output unit. The type of microcontroller used in this project is Arduino Mini (ATmega328P). The IC is programmed by using the embedded C-language. Its pinouts are connected to the input and output units.

The ultrasonic sensor is connected to pins 2 and 3 of the microcontroller. Figure 5 shows the circuit connections of the control unit to the other units. Pin 4 is connected to the buzzer and it is set to a low voltage at the initial stage of the system, then it is set to high when an intruder is detected.The GSM module is connected to the pin 11 and 10 of the control unit. The microcontroller communicates with the GSM module via the use of its serial port. The serial port has a transmission terminal (Tx) and the receiver terminal (Rx). The baud rate of transmission of data is 9600 bits per second (bps). The microcontroller and the GSM module will communicate using the same baud rate (i.e. 9600 bps). It receives a signal from the input unit and sends the corresponding signal to the output unit. The sensor signal is sent to the input where calibration is done. This is the display on the liquid crystal display

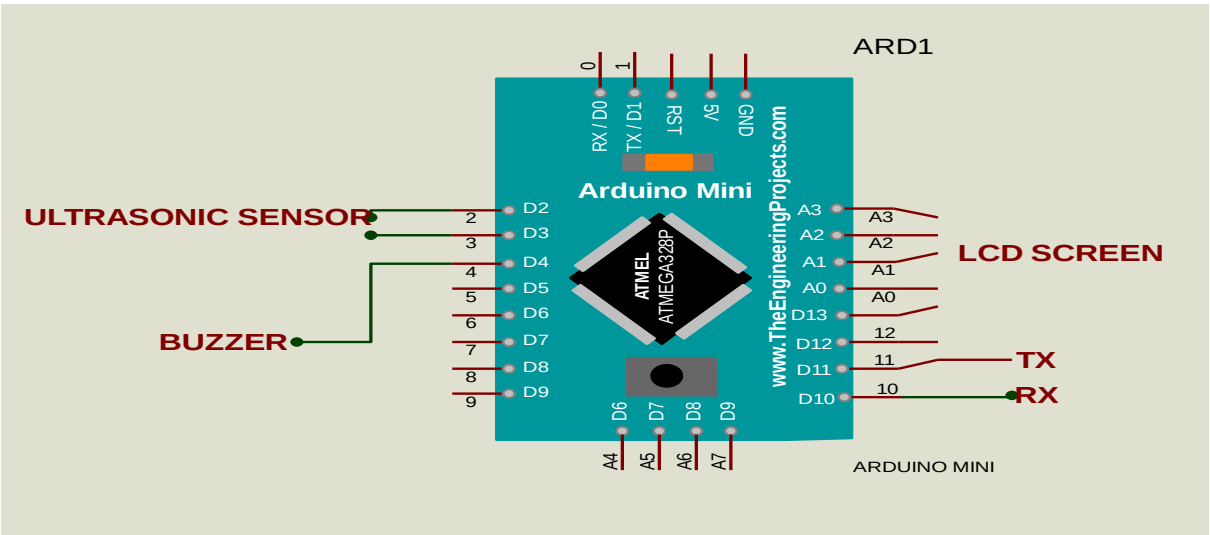

Figure 5: Circuit Diagram of the Control Unit

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f)Output Unit

The output unit is made up of the liquid crystal display (LCD), the GSM module and the buzzer system. The buzzer is connected to the microcontroller via the transistor (Q3). The resistor (R7) limits the current entering the base of the transistor. The collector is connected to one of the terminals of the buzzer, and the emitter is connected to the ground.

The GSM module is used to transfer data from the system wireless via the use of a telecommunication network to the phones of the users to alert them of possible intrusion detection. The SIM card used in the work is a GSM SIM, and it means the network used in the transmission is the MTN telecommunication network. The microcontroller can communicate with the GSM module by the use of AT commands that is sent to the GSM module from the control unit. The serial communication used is a duplex format, which means that data is sent and received by the GSM using the Rx and Tx terminal of the module. The baud rate of transmission between the microcontroller and the module is 9600 bps. The LCD is connected to the microcontroller. The communication between the microcontroller and the LCD is a nibble parallel communication. It uses four-bit to transfer information or ASCII character from the microcontroller to the LCD.

IV. CONSTRUCTION OF CIRCUIT AND TESTING

The circuit design and analysis were done with the various components mentioned in section (III-A) of this paper.The components were bought from the market and assembled for construction process. The circuit was designed and analysed using software Proteus version 7.8 – an electrical drawing studio environment. The software was used to simulate some of the parts of the circuit to ensure the design works properly. Then the components of each part of the security system were soldered onto a Vero-board. The power supply unit was built first followed by the input unit, control unit and lastly the output unit.

The testing of the system starts from individual component testing before soldering and then each stage was tested. This approach enables one to trace the fault and easily adjust it.The power supply unit was checked for proper voltage level from its output pins with a multi-meter. The power supply unit gave the expected voltages of 5Vdc. The input devices, the ultrasonic module was tested and confirmed working before proceeding to the control unit. The output from the input unit was connected to the microcontroller. The buzzer system was connected to the circuit and it was controlled by the circuit. The GSM module gave the alert messages as expected. The C- program for the microcontroller was simulated, checked for errors and debuggedusing the assembler before it was burned into the microcontroller chip. The entire circuitry of Figure 2 was tested and it delivered the expected results.

V. CONCLUSION

The GSM Alert electronic eye security system works as a transceiver that sends and receives the signal with the help of the ultrasonic sensor which is its primary function to transmit and receive signals. The GSM module is used to send SMS to several numbers embedded in the controller, which alerts the owners of possible intruder detection. The design is made to detect any movement in an enclosed area.The result shows what happens when there is an intruder, the buzzer which acts as the alarming system, turns on until the messages are completely sent to the security personnel. The alarming of the device and sending of SMS makes the system works in two ways. The first is alarming, creating awareness for those around and the second, is to create security awareness by sending SMS hence the system works in both short and long distances.The main contribution of this work is the design of a circuit that can sense motion through the movement of anything, a low cost and portable motion detector.

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