Design, Development and Performance Study of L³- Home Security System

By B V Sumangala & K Bhargava Ram

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Abstract - All over the world, security has been a major concern in every home. Here, a security system has been developed that uses sensors to detect any security violation and sends out the alert signal by high intensity Buzzer. The system mainly consists of LDR, Laser, Logic Gates, Microcontroller IC, LCD, Keypad and Relay Circuit. L3 stands for LDR, Laser and Logic Gates as these 3 components form the core idea of the system. This system is mainly implemented on the present doors with lock-key method. Thus providing Double Authentication i.e. the door can only be opened with the right password and right key. Another feature of the system being that, using different logic gates combination the system is designed in such a way that the buzzer won't be switched off even though the intruder cuts the wires connecting the Buzzer and main control circuit. The system is designed and developed using simple locally available components and by considering every tiny factor it is made both reliable and affordable. Performance and cost analysis studies are also carried and also a glance into the future upgradations such as SMS service, PIR sensors and IR sensors that be introduced in the system.

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DESIGN,DEVELOPMENTANDPERFORMANCESTUDYOFL-HOMESECURITYSYSTEM

Strictly as per the compliance and regulations of:

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Abstract - All over the world, security has been a major concern in every home. Here, a security system has been developed that uses sensors to detect any security violation and sends out the alert signal by high intensity Buzzer. The system mainly consists of LDR, Laser, Logic Gates, Microcontroller IC, LCD, Keypad and Relay Circuit. L³ stands for LDR, Laser and Logic Gates as these 3 components form the core idea of the system. This system is mainly implemented on the present doors with lock-key method. Thus providing Double Authentication i.e. the door can only be opened with the right password and right key. Another feature of the system being that, using different logic gates combination the system is designed in such a way that the buzzer won't be switched off even though the intruder cuts the wires connecting the Buzzer and main control circuit. The system is designed and developed using simple locally available components and by considering every tiny factor it is made both reliable and affordable. Performance and cost analysis studies are also carried and also a glance into the future upgradations such as SMS service, PIR sensors and IR sensors that be introduced in the system.

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I. INTRODUCTION

a) Home Automation

In simple terms home automation is defined as the automatic control of all appliances at home. It's something like this: when you get up from bed, the pressure sensor kept under your bed mat sends the signal to the coffee maker which makes the coffee and heater in your bathroom switches on simultaneously [1]. Lights and fans switch ON and OFF based on the humans presence in the room all by itself. These technologies are no more the dream but are now becoming the reality around us.

Home Security Automation: Non-Automated security systems were found non-reliable. Doors were fitted with lock and key system which can be opened easily. Even the human presence of security guard may not be completely trustworthy. Every system from the past has been found to be very much vulnerable. Home is a place where security is must, to keep all the valuables and appliances safe. The owner should have the confidence to step out of the house with the feel that

nothing can happen to the Home. This feel will only arise when the home is equipped with a reliable security system.

How: This reliable home security system can be made possible with Home Security Automations. Over the years many systems are being designed for this purpose. Password Authentications like the ATMs, which are equipped with RFID or Biometric System and Cameras with image processing, Zigbee based security system, PIC based security system, SMS based security system etc. has been designed and implemented [2].

But the cost of the systems is relatively high, thus making it available to the only to the rich.

With this issue in focus, we tried to design a home security system which will be of low cost and provide adequate security levels for the home, thus making it reliable and affordable to every class of families.
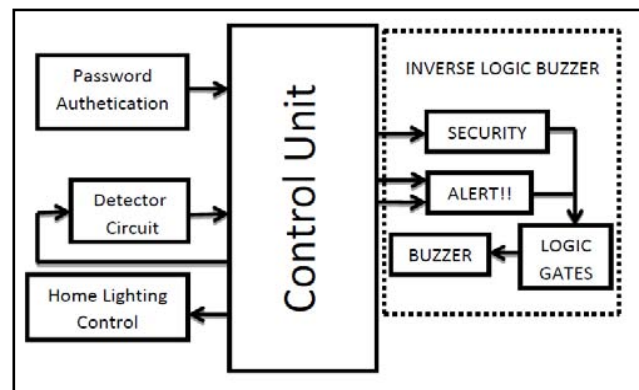
II. BLOCK DIAGRAM

Figure 1 : Block Diagram Representation of the Security System

III. SYSTEM OVERVIEW

a) Control Unit

32 pins AT89V51RD2 Microcontroller is the control unit in the security system with a crystal oscillator to set accurate 12 MHz frequency. The microcontroller is programmed using C language.

b) Password Authentication

i. *Components Description*

1) *LCD – KEYPAD:* LM016 2 lines LCD (Liquid Crystal Display) in combination with 4X3 Keypad

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is used to enter password and verifications[3]. LCD is used mainly to provide better user interfacing, such as to display "Enter Password:", "Home Lighting (Y/N)", "ALARM ON" etc.

2) *EEPROM:* A Parallel 16K (2Kx8) EEPROM [4] (Electrically Erasable Programmable Read Only Memory) is provided as an external memory. EEPROM is used to store the password and is again accessed when a password has to be changed.

[Note: A series EEPROM can also be used in this application. To decrease the programming complexity Parallel EEPROM is selected]

The Password Authentication provides a secured gateway to enter the home. The owner activates/deactivates the security system by entering the password. When security system is switched ON, simultaneously the Detector Circuit, Inverse Logic Buzzer and Home Lighting Control inputs varies based on its mode of operation.
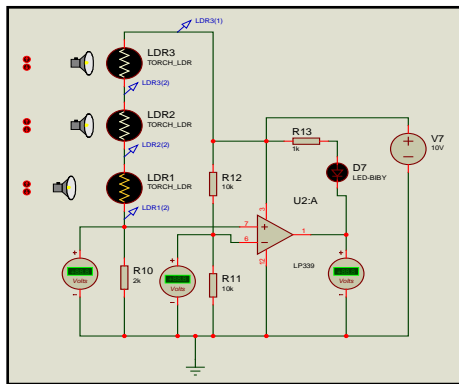
c) *Detector Circuit*

Figure 2 : Circuit Connection of Detector Circuit

Detector Circuit is placed behind the main door whereas the Password Authentication system is at the front as shown in the figure 2. The detector circuit is a combination of LDR (Light Dependent Resistor) and Laser. The LDR has the property of possessing a high resistance in the range of Kilo to Mega ohms in normal condition [5]. When a high intensity light is incident on the LDR, the resistance drops to 300-400 ohms. In the circuit, there is a 10V DC supply along with two potential dividers (R11, R12) and R10, LDR resistance. Due to the R11 and R12 potential divider, the voltage drop across R11 is 5 volts providing 5 volts to the negative terminal of the LP339 comparator [6]. Once the home security is switched ON, the LDR LASER circuit will get activated. This means that the laser light will be incident on the light dependent resistor. As the laser light is incident on the LDR, its resistance is lower than R10 creating a drop such that the voltage available at the positive terminal of the comparator is higher than the voltage at the negative terminal. Hence the comparator output will be high and

LED will not glow. If the laser light is switched off or cut due to some obstruction, the LDR resistance will increase. Hence the drop across it will increase producing a lower voltage at the positive terminal. As a result, the comparator output will be low and the LED starts glowing indicating that someone has disturbed the sensor system. The output of comparator is connected to port of the microcontroller (feedback loop).
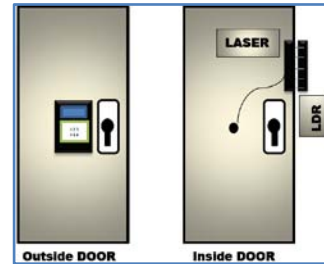

Figure 3 : Pictorial representation of how Password Authentication and Detector Circuit are implemented

Double Authentication: Thus it is observed that the door can only be opened with the right password and right key to the lock. Even the present doors need not be replaced but just a small hole (approx 1cm radius) on the door is sufficient to install this system. Thus the security system is reliable and also easy to implement.
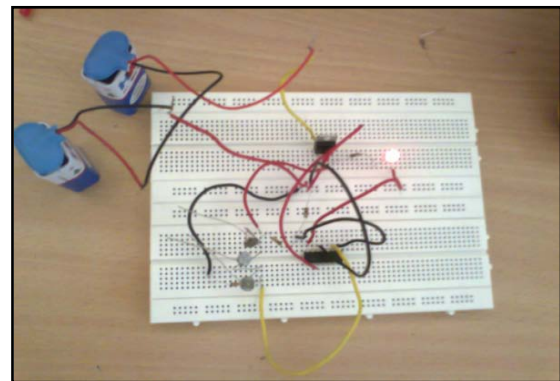

Figure 4 : Real Time working of Detector Circuit
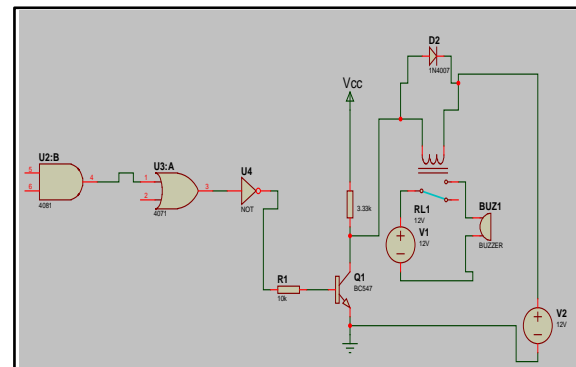
d) *Inverse Logic Buzzer*

Figure 5 : Circuit Connections of Inverse Logic Buzzer

[Note: *The inputs of "AND Gate" and "OR Gate" are connected to the port pin of microcontroller*]

When wiring was used to switch ON the Buzzer, questions would be raised about what will happen if someone enters the home illegally and cuts the wire that connects main system to Buzzer.

For that reason using logic gates and applying inverse logic concept, a system is designed in such a way that even though the intruder cuts the wires the Buzzer doesn't switch OFF.

[Note: In real time connections the 74LS08 QUAD input AND Gate and 74LS32 Quad Input OR Gate will be used [7]]

1) Working

The Inverse Logic Buzzer has 3 logic gates: AND, OR and NOT with a Buzzer.

OR Gate input changes based on the status of security system, 0- activated and 1-deactivated.

The 2 Inputs of AND gate signify the state of Detector Circuit and Password Authentication.

Initially when security is switched ON the inputs of AND is HIGH and OR Gates LOW, thus the output of OR is HIGH and the NOT gate inverses the signal from HIGH to LOW and the relay is not energized, Buzzer is OFF.

When an intruder breaks into the house, the detector circuit is disturbed and input of the AND gate changes from HIGH to LOW. Thus the output of OR gate will be LOW and the NOT gates inverses signal to HIGH, thus relay is energized and the Buzzer switches ON. The same principle discussed above is followed when a Wrong Password is entered (multiple times).

So the intruder should search for the main location of the buzzer, running along the wire. For best efficient working of buzzer, it is preferable to use multiple buzzers placed in different places, i.e. rooms. So that by the time the intruder finds and stops all the buzzers the entire surrounding neighbourhood area would have been alerted.

2) Relay Circuit Working

✓ OFF Condition: When the transistor (BC 547 npn) is OFF, the two voltage supplies Vcc and V6 tend to flow through the same path, opposing one another. Hence the relay coil is not energized properly and the contact switch remains open. The Buzzer is OFF.

✓ ON Condition: When the transistor is ON, the supply from Vcc gets grounded. The V6 energizes the coil, enabling the closing of the contact switch and Buzzer is switched ON.

IV. Complete Working of L³

The system is placed on the door as explained before. When the owner is leaving the home, the system is activated by entering the right password using the Keypad. The right password is verified by checking the entered password with the password stored in the EEPROM. Activating the system means that the Buzzer and Detector Circuit are energized.

Then an option to switch ON/OFF the Home Lighting is requested. At times when parents are leaving home with their kids at home doesn't prefer to cut OFF the power supply, so for that an option is provided to keep the lightings ON or OFF and the power is monitored through higher withstanding capacity relay.

Once the option is provided and the owner left the home, the security system gets activated. System is deactivated only when the right password is entered with the right key to the door lock, thus providing Double Authentication to the home.

If an intruder attempts to break into home by either forcibly opening the door or by placing a duplicate key, the detector circuit is disturbed (as the right password is not entered) and the Buzzer is switched ON.

Few other details that have been taken care are:

✓ Once the Buzzers gets activated it switches OFF the Laser Circuit, so that even if the intruder closes the door after breaking in, it doesn't deactivate the alarm as the Laser won't fall on LDR anymore.

✓ By giving a delay loop in such a way that the detector circuit gets disturbed only when Laser stops falling on the LDR for around 1sec. Thus if any minute dust particle passes through gap between the LDR-Laser doesn't trigger the buzzer.

✓ Even if the intruder tries to break the password system placed on the door to disable the security system, the outputs of the logic gates goes LOW and Buzzer turns ON automatically.

✓ As observed the system is divided into different sections and each section is supplied with a secondary supply unit (Batteries), so that even if the main supply is cut off the system will shift on to the backup power provided. As the sections are divided it will be easy to add separate power supply.
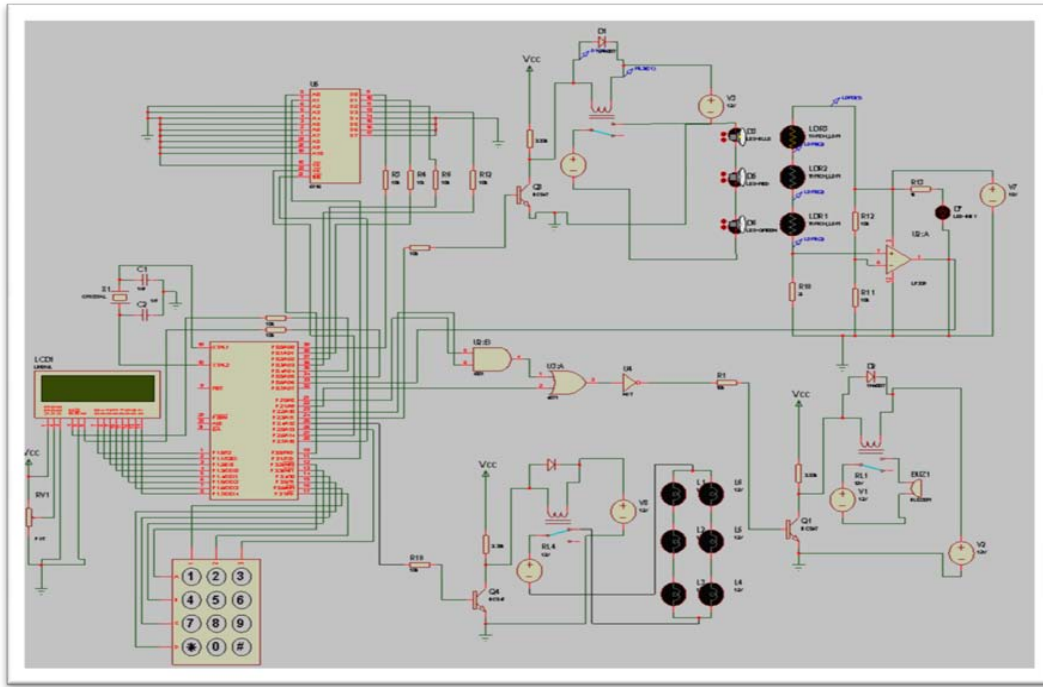
Figure 6 : Complete circuit connection of the prototype design of L3 Home Security System
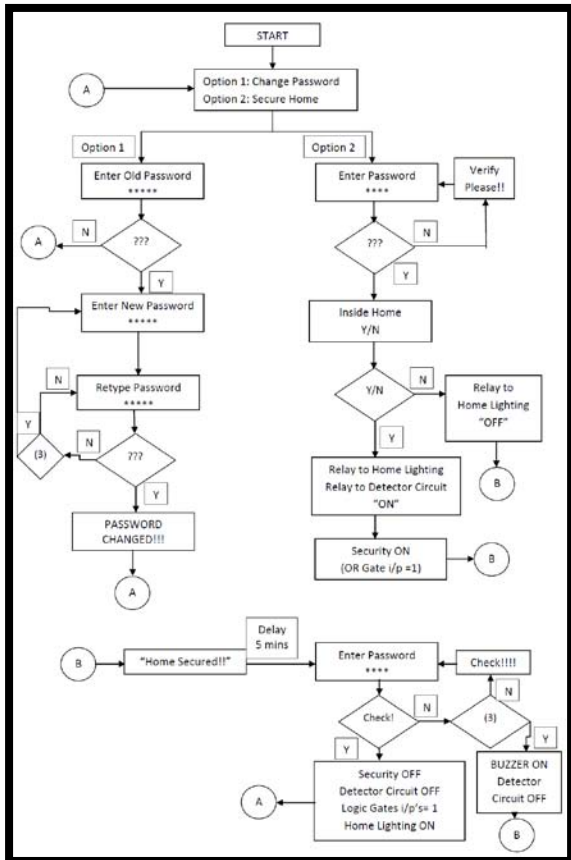
FLOW CHART

Figure 7 : Program Algorithm for L³ Security System. The program was framed using C Language in Kiel µVision Software [8].

V. COST ANALYSIS

For the proposed system, components of the system are available in local market. The recent cost for entire the system is given below.

Table 1 : Production Cost of L3 Security System [#]

Sl.no	Component Name	Cost (INR)
1	AT89V51RD2 Microcontroller	100
2	Crystal Oscillator	20
3	Electromagnetic Relay – 4	40
3	Detector Circuit (Laser + LDR + LP339)	200
4	Password Authentication (LCD LM016 + 4X3 Keypad + EEPROM)	200
5	Logic Gate IC's (74LS08 AND + 74LS32 OR)	30
6	Power Supply (Batteries + Step Down Transformer)	250
7	Design Accessories (PCB + Resistors + Capacitors, etc.)	150
	TOTAL =	990 /-

[#] – According to cost estimation made in May 2012, in Bangalore, India

a) Low Cost

The L³ Home Security System is a security system designed especially for existing homes and also its application to shops, banks etc. The system is

developed to make very affordable to reliable security system. Although there are existing security systems for that price, the L³ differ from them in many ways. The system was designed using locally available components and it is very cheap. The double authentication system with the inverse logic alert signal makes L³ different from the existing systems. The home security is low cost, reliable and can be easily implemented.

VI. FUTURE UPGRADATIONS

a) SMS Service

At times if the home is at an isolated locality, a buzzer won't alert the neighbors. In such conditions, another alert signal can be generated by sending alert SMS using GSM device to the owners or to nearby police station.
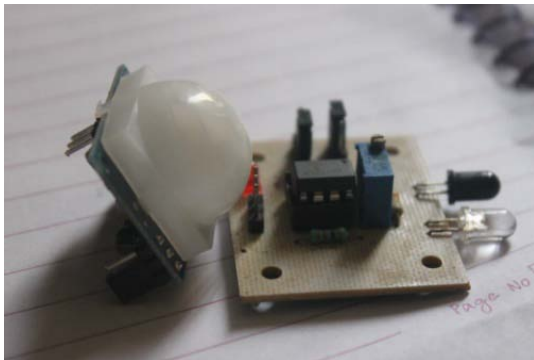
b) Other Sensors

Figure 8 : PIR and IR sensor

1) PIR Sensors: PIR [9] i.e. Passive Infrared Sensor is used as a motion and fire detection sensor. In the home it is mounted at height of about 3m at a corner of a room. 12V DC is given to the PIR to power the sensor. The circuit switch is normally closed when the motion is not activated. As soon as the PIR senses considerable temperature change, which can be due to motion or fire, the circuit switch opens. 5V DC is given to the normally closed switch. Thus at the start it sends high signal to the AND gate (as per explanation from section III). When motion is detected, circuit switch is open thus LOW signal is send to AND which switches ON the buzzer as per Inverse Logic concept (refer section 3.4).

2) IR Sensors: IR (Infra Red) sensors are used for motion detection. IR working concept is similar to that of Detector Circuit. When the transmitter signal is being received by Receiver, output signal is HIGH. Then the signal is disturbed, i.e. someone interferes in between the receiver stops receiving signal from transmitter. At thus condition the output signal will be LOW. The output signal is generated based on the closing and opening of switch at the Relay Circuit. Thus IR sensors can be used for

detection at doors, windows etc, to restrict the entry of intruder through doors or windows other than the main entry door.
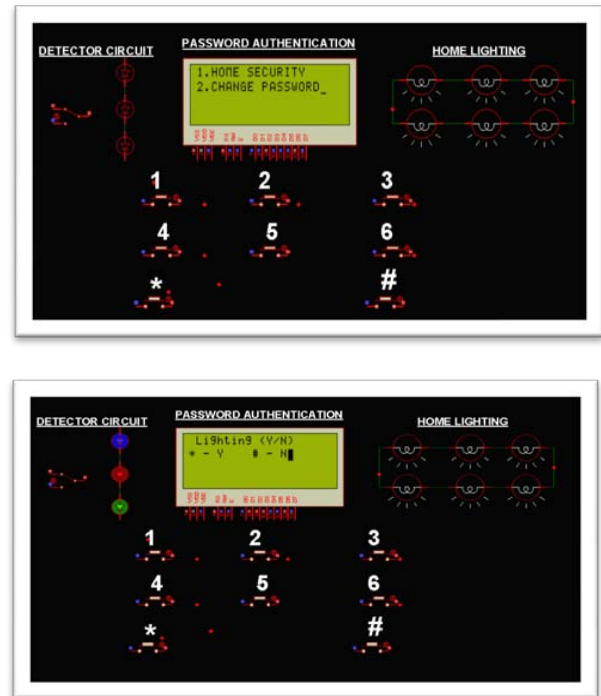
VII. SIMULATION RESULT

Figure 9 : Snapshots of running simulation of home security system using Proteus ISIS 7 Professional

VIII. CONCLUSION

The present technology for Home Security Automation at entry level involves systems like RFID cards, Biometrics Access System, ZIGBEE based etc. These systems provide a very high level of security to home, but comes with high price thus limiting the security system accessible only to wealthy families. These features also come with great complexity in designing, working and implementation.

Thus we attempted to design a system which can be affordable to every home within a feasible price which is less than 5000 INR, i.e. approximately **100 USD** (includes the installment and future upgradations). Also the working of the system is simple and easily can be implemented on existing doors without the need of replacing or modifying the door.

IX. ACKNOWLEDGEMENT

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REFERENCES RÉFÉRENCES REFERENCIAS

1. Electronics for You Magazine, *"Smart Homes Technology"* Vol. 43, No. 10.
2. Tabinder Akter, Mahfuja Akter, Mohammad Mozammel Hoque, Md. Afzalur Rab & Dr Md Habibur Rahman, *"Design, Development and Performance Study of a Microcontroller-Based Home Security System Using Mobile Phone"* Global Journal of researches in engineering Electrical and Electronics, Volume 12 Issue 6 Version 1.0 May 2012.
3. Inderpreet Kaur, "*Microcontroller Based Home Automation System with Security",* International Journal of Advanced Computer Science and Applications (IJACSA), Vol. 1, No. 6, December 2010.
4. Atmel Corporation, "Atmega16 Datasheet" http://www.atmel.com/dyn/resources/prod_documents/doc0270.pdf
5. Sensors interface to Microcontroller. http://www.youtube.com/watch?v=KKb_cv9hJlI&feature=related
6. Texas Instruments LP339 Datasheet http://www.ti.com/lit/ds/symlink/lp339_n.pdf
7. "*An Illustrative Approach to Logic Design*" by R D Sudhaker Samuel.
8. *"The 8051 Microcontroller and Embedded Systems Using Assembly and C"* 2nd Edition by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay,
9. Sheikh Izzal Azid, Sushil Kumar, "*Analysis and Performance of a Low Cost SMS Based Home Security System"* International Journal of Smart Home Vol. 5, No. 3, July, 2011.

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