AHMED SHAHAME MWIDANI TECHNICAL INSTITUTE

Department of Mechatronic Engineering

Final Year Project Proposal

INTRUDER ALERT SYSTEM USING LDR SENSOR AND ARDUINO NANO

By Kevin Mwendia

SUPERVISORS

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2.

ACKNOWLEDGEMENT

I recognize with paramount appreciativeness the Almighty God for the far I have reached. The guidance of my project supervisor Mr. Melvin for his input throughout the project and highly appreciates and don't take it for granted.

The department of mechatronic engineering was instrumental in providing the information required for the project completion.

I acknowledge the support from chairman of mechatronic department who guided me immensely to bring my idea to an accomplishment. I extend my gratitude to my parents for their financial support throughout my course. Thank you to everyone who took part in completion of the project.

DECLARATION

This project is my original work which I have acknowledged to the owners of the ideas. It is to the best of my awareness that the following idea has not been previously submitted to the institution or any other university.

Name: Kelvin Irungu Reg. No: Signature:

SUPERVISOR'S DECLARATION

This project has been submitted to the department with our approval as the supervisors

I.
II.

ABSTRACT

This project presents an efficient and cost-effective intruder detection using a Light Dependent Resistor (LDR) sensor and Arduino Nano microcontroller. The LDR sensor detects changes in ambient light conditions triggered by an intruder's presence. This signals the Arduino Nano to initiate an alarm or the alert system (buzzer).

The Arduino Nano processes the LDR sensor data utilizing a predefined threshold to distinguish between normal and suspicious light variations. The system is designed to be easily deployed in various environments making it an accessible solution for enhancing security in both residential and commercial settings.

The integration of LDR with Arduino Nano offers a reliable and adaptable approach to intruder detection contributing to overall safety and protection of the area being monitored.

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1. INTRODUCTION

1.1. Background

Intruders used different methods to enter restricted property without the owner's consent. This leads to different circumstances where the owner has no idea of when the incident happened. As observed in most banks where the robbery happens and the cashier or staff is not able to press the alarm button or switch. In this project I will be majoring in obstruction indicator using LDR sensor. This will be used to enhance security and as an alert system where if the sensor is blocked it will produce a continuous alarm through a buzzer alerting the owner of an intruder.

The device is programmed to detect according to delay of the obstacle. Unlike alarms where the owner has to go and switch on the alarm, LDR is able to detect and switch on automatically. This will help ease the silent intrusion.

1.2. Problem Statement

Due to intrusion of property through various mean, the owner is not able to know when intrusion happen and is caught off guard by the intruder. This causes the owner is not able to press the alarm button or switch which cause to delay to ask for help from surrounding neighbor or security office.

1.3. Justification Of Study

Intrusion of restricted property has increased and hence I have designed the alert system using ldr sensor and Arduino to help carb the scenario where the owner is unable to know in case of intruder.

1.4. Project Objectives

- To design and assemble an obstacle detector using ldr sensor.
- To facilitate in securing and alerting the person in case of intruder.

2. LITERATURE REVIEW

Intruder alert system using ldr sensor exhibits a growing interest in cost effective and trustworthy security solutions which include;

i. Sensitivity calibration and optimization

Calibration technique is explored to enhance the sensitivity and accuracy of LDR in detecting subtle changes in light condition.

ii. Alert mechanism

A buzzer produces sound in response to an obstacle which acts as an alarm.

iii. Basic Principle and System Architecture

Research outlines the fundamental concept of using LDRs to detect changes in ambient light caused by an intruder.

2.1.1 Existing Technologies

i. Threshold-based Triggering :

Many systems employ a threshold-based triggering where an alert is activated when the LDR readings falls below or rises above a predefined threshold.

b. Time-of-Flight (ToF) Sensors:

Various radical systems integrate ToF sensors alongside LDRs to measure the time light takes to travel to the target and back enhancing accuracy in detecting intruders

c. Machine Learning Algorithms:

In more sophisticated structures, machine learning algorithms are applied to analyze patterns in LDR data, improving the system's ability to distinguish between normal environmental changes and potential intrusion.

d. Multi-sensor Integration:

Combining LDRs with other sensors like passive infrared (PIR) or ultrasonic sensors helps improve overall intruder detection accuracy and reduces false alarms.

2.2 Theoretical review

2.2.1 Arduino Nano

An Arduino board consists of an Atmel 8-, 16- or 32- bit AVR micro controller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors which lets users connect the CPU board to a variety of interchangeable add-on modules known as shields. Most boards include a 5 volt linear regulator and a 16 MHz crystal oscillator. An Arduino microcontroller is pre-programmed with a boot loader that simplifies uploading of programs to the on-clip flash memory.

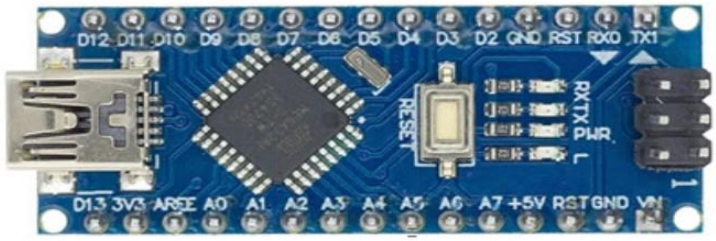


Figure1. Arduino Nano

Arduino Nano is much like Arduino Uno just that Nano lacks the DC power jack and contains a mini-B type USB connector. It's based on ATmega328p microcontroller.

Arduino Nano Board Layout

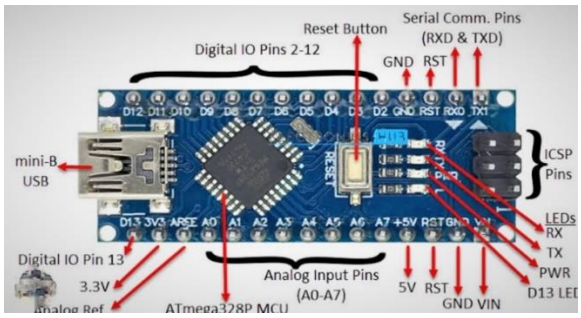


Figure2. Layout of Arduino Nano board

Technical Specification of Arduino Nano

MCU	ATmega328p
Architecture	AVR
Operating voltage	5V
Input voltage	7V – 12V
Clock speed	16 MHz
Flash Memory	32 KB(2 KB 0f this used by boot loader)
SRAM	2 KB
EEPROM	1 KB
Digital IO Pins	22 (of which 6 can produce PWM)
Analog IO Pins	8

❖ Programming

The Arduino Nano board can be programmed using the Arduino Integrated Development Environment (IDE), which is available on Arduino website. It supports wide range of programming languages including; C, C++ and a simplified version of C called Arduino programming language.

❖ Power

Arduino Nano can be powered through couple of ways. The first and easy way is using mini-B type USB connecter. Next is, providing a regulated 5V supply through the 5V pin. The last way, the Nano has an onboard regulator at the bottom (along with the USB – to – Serial Converter). Usually used when an unregulated supply in the range of 6V to 20V to VIN pin of the Nano.

❖ Memory

There are three different types of memories available in ATmega328P. They include

- 32 KB of Flash Memory
- 2 KB of SRAM
- 1 KB of EEPROM
- 2 KB of Flash Memory is used by the boot loader code

❖ Input and output

It consists of digital and analog input/output (I/O) pins. There are five key features

- Digital I/O- It have 14 digital I/O pins that can be constituted as input or output. The pins can be used to deliver digital signals from devices.
- Analog input- There are 8 analog inputs used to read analog signal from sensors.
- PWM output- Nano has 6 PWM (Pulse Width Modulation) that generate analog signals that require analog control.
- SPI- Arduino Nano has a SPI (Serial Peripheral Interface) port that is used to communicate with other devices e.g. sensors, display modules or other microcontrollers.
- 12C- It consists of 12C (Inter-Integrated Circuit) used for communication.

❖ Physical characteristics and shield compatibility

Arduino Nano board has a dimension of 18mm * 45mm. weight of 7grams, power through a USB connection or an external power source of 7-12V DC. There are 30 pins including 14 digital pins, 8 analog pins and 6 PWM pins. It is based the ATmega328P microcontroller chip.

Concerning shield compatibility, the Arduino Nano board is compatible with many shields. However, due to its smaller size, the Arduino Nano may not be compatible with larger shields that require more space. Besides that some shields may require modifications to work with the Arduino Nano such as changing the pin mappings or adding supplementary components to provide voltage regulation.

2.2.2 220-ohm Resistor

A resistor is an electronic component that limits the flow of electric current. As for the 220-ohm resistor, it would impend the current passing through it hence creating a voltage drop proportional to the current and resistance according to Ohm's law (V =I*R). In this project it will be used to limit the current for LEDs or as part of voltage dividers.

Figure3. 220-ohm resistor

2.2.3 Buzzer

A buzzer is a sounding device that covert audio signal into sound signals hence used as sound device. It is powered by DC voltage.

Figure4. Buzzer

- Working.

As for our case we will be using the piezo buzzer. The piezoelectric buzzer uses the piezoelectric effect of the piezoelectric ceramics and uses the pulse current to drive the vibration of the metal plate to generate sound. Piezoelectric buzzer is mainly composed multi-resonator, piezoelectric plate, impedance matcher, resonance box, housing etc. some are equipped with light emitting diodes. The multi-resonator has

transistors or integrated circuits. When the power supply is switched on (1.5-15V DC operating voltage), the multi-oscillates and outputs 1.5-2.5 kHz audio signal. The impedance matcher pushes the piezoelectric plate to generate sound. After being polarized and aged, the silver electrodes are bonded together with brass or stainless steel sheets.

2.2.4 LDR (Light-Dependent Resistor)

Is a component in an electronic circuit that exhibits a change in resistance based on the intensity of light falling on it. The resistance of an LDR typically ranges from several kilohms in darkness to a few hundred ohms in bright light conditions.

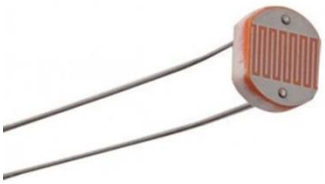


Figure5. LDR Sensor

❖ Working principle

LDR sensors work on the principle of photoconductivity. As light intensity increases, the resistance of the LDR decreases and vice versa.

2.2.5 LED (Light Emitting Diodes)

LEDs are semiconductor devices that emit light when an electric current passes through them. There are 3 types of LEDs i.e.

a. Standard LEDs- emit light in a specific color.
b. RGB LEDs- contain red, green and blue components enabling the creation of various colors.
c. High-power LEDs- designed for application requiring intense illumination.
d. Surface Mount LEDs- compact and suitable for PCB (Printed Circuit Board) mounting.

Figure6. RGB LEDs (red and green colors)

❖ Working Principle

LEDs operate on the principle of electroluminescence. When electrons combine with holes in the semiconductor material, they release energy in the form of light.

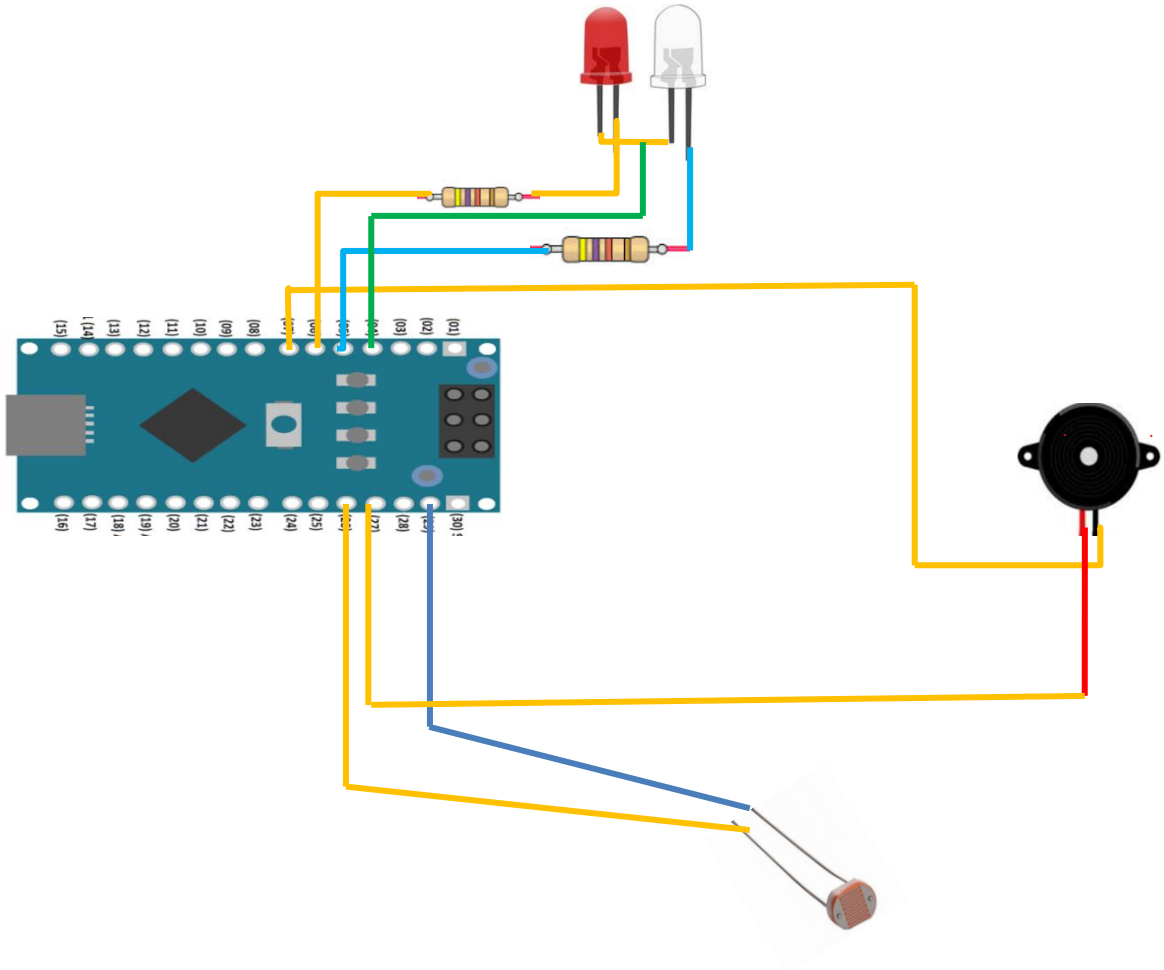
3. METHODOLOGY

3.1 System Overview

In this project, am going to interface an LDR sensor with and Arduino Nano. LDR detects changes in ambient light conditions caused by an intruder. The LDR is connected to the Arduino Nano through analog pin circuitry using resistors which helps convert changes in resistance from LDR into corresponding voltages changes. A predefined threshold is set based on calibration and testing of differentiate between normal light fluctuations and potential intrusion. If voltage falls below this threshold indicating possible intruder blocking light, the system considers it an intrusion alert.

Upon detecting the intruder, the Arduino triggers the green LED to flash for a few second if the obstacle will move. If the delay of obstacle continues for a specified seconds, the red LED is activated which flashes continuously. The buzzer is activated which produces sound acting as an alarm to alert of intrusion.

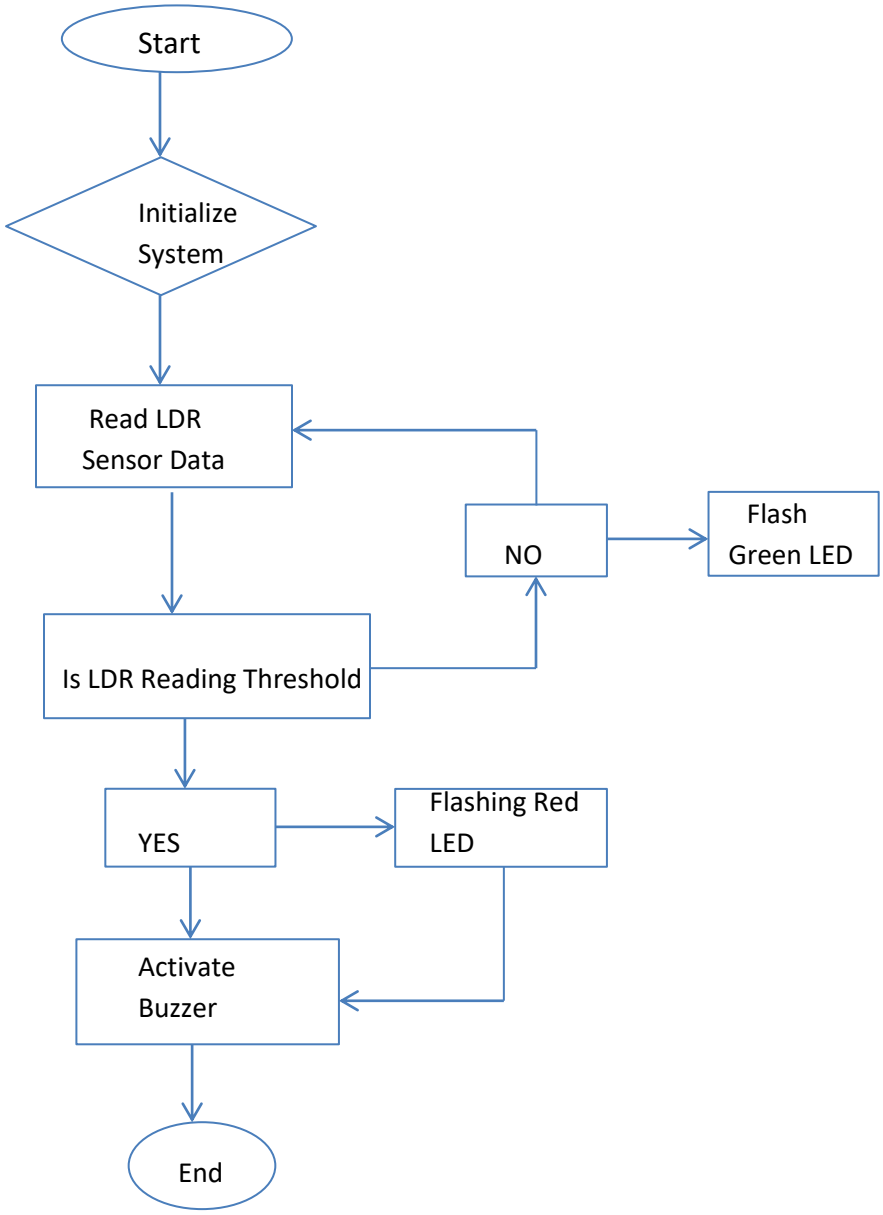
3.2 Circuit Diagram



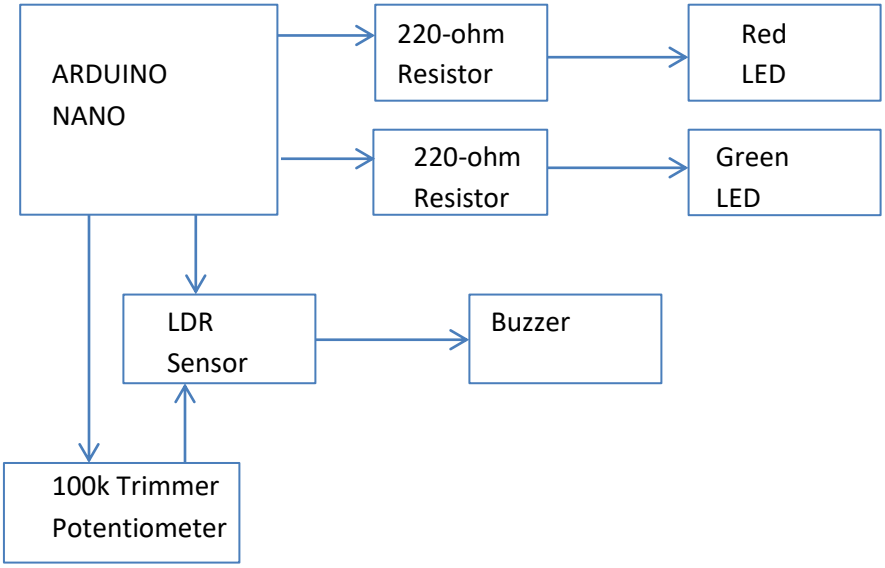
3.3 Programming

The code is written in the Arduino platform using Arduino software.

3.4 Flowchart



3.5 Block Diagram



3.6 Operation

The LDR sensor continuously reads data using analog input of the Arduino Nano. This data represents ambient light conditions. A threshold is established based on calibration and testing which is used to determine when a significant change in light condition occurs indicating a potential obstruction.

If the LDR reading falls below threshold, it suggests a decrease in ambient light possibly due to obstruction hence an intruder detected. This triggers the system to consider an intrusion which activates the buzzer and flashing red LED hence the buzzer act as an alarm.

4 EXPECTED RESULTS

In normal conditions, the system continuously monitors the LDR sensor data thus the readings remain above the predefined threshold indicating unobstructed ambient light thus no intrusion. When an obstruction occurs, (object blocking light to the LDR) the reading of the LDR fall below the threshold. The system detects the change and infers it as an intrusion. When intrusion is detected, the green LED is activated and flashes but after few seconds, the red LED is activated and flashes continuously and the buzzer is activated which acts as an alarm.

The system returns to continuous monitoring after detecting the intruder hence resumes reading the LDR sensor data and checking for change in light conditions. The system operates on endless loop continually monitoring, detecting and alerting as required.

5 TIME PLAN

MONTHS / TASKS	MAY	JUN	JULY	AUGUST	SEPT	OCT	NOV	DEC
LITERATURE REVIEW								
MECHANICAL DESIDN								
ELECTRONIC CIRCUIT DESIGN								
PROGRAMMING								
PRESENTATION OF PROJECT PROPOSAL								
MECHANICAL PARTS FABRICATION								
ELECTRONIC SYSTEM ASSEMBLY								
ASSEMBLY OF ENTIRESYSTEM								
SYSTEM TESTING AND CALLIBRATION								
DOCUMENTATION								
FINAL PROJECT PRESENTATION								

6 **BUDGET**

ITEM	SPECIFICATION	QUANTITY	PRICE (KSH)
Arduino Nano		1	1400
LDR (Light-Dependent Resistor) Sensor		1	20
Resistor	220-ohm	2	10

Buzzer	Piezo electric buzzer	1	50
LED (Light Emitting Diodes)	Green and Red LEDs	2	10
Breadboard		1	300
Jumper wires	Red, Blue and Orange	10	40
TOTAL			1850

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