

# CCTV Using Arduino

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**Abstract:** Theft from museums and secure areas is very costly to the world. There are many ways to avoid the theft, which includes having a security personnel to watch the place. Due to high cost, hiring the personnel is almost not feasible. Here, we have a very low-cost system based on Arduino UNO (ATmega328) board. It uses PIR sensor, GSM module, buzzer, and motion camera connected to PC for real time surveillance of the items kept in the display shelves. The motion detection system works in three ways; instant alarm and LED through the buzzer on the site, capturing the thief's footage through the camera, and instant GSM SMS/call notification to the owner. The system is programmed using Arduino IDE using embedded C to communicate with its wireless components. Low Power 24/7 Monitoring Tamper Resistant Easy to Install Expandable (Laser) Suitable for shops, museums and private homes The system effectively prevents theft by deterring, by proof of the fact that there is video evidence and quickly reacting to any attempt to steal.

**Keywords:** Arduino UNO, PIR sensor, GSM module, motion camera, wireless alerts, ATmega328

## 1. INTRODUCTION:

Advanced technologies make life easier by allowing people to protect their belongings from thieves even if they are located in separate places. Due to theft in homes, offices, and organisations, most people are concerned about how to protect their items such as ornaments, vital documents, and the money kept at home. As a result, the majority of housewives employ almanacks and secure lockers in their homes to protect their valuables. However, they continued to employ a manual lock and key mechanism, offering no notification to the customer when a theft occurred by breaking them. When our belongings are taken away, Arduino sends a notification to your phone. In this paper, we show how Arduino recognises whether or not a robbery has occurred. The Arduino is used in conjunction with a mobile phone and a motion detecting camera in this study to create a security system. The current system does not provide accurate results. The suggested system includes a PIR motion sensor that detects motion in the environment and assists in motion capture using a camera. It also delivers the signals to the Arduino which produces the output. When someone steals his belongings, it makes a call to the owner.

## 2. LITERATURE SURVEY

### 1. Arduino Uno:

Arduino Uno is a microcontroller board based on Atmega328. Arduino Uno already contains everything needed to support the microcontroller and easily connects it to a computer with a USB cable or supplies it with an AC to DC adapter or uses a battery to get it started. ATmega328 on Arduino Uno comes with a bootloader that allows us to upload new code to ATmega328 without using an external hardware program .

### 2. Bluetooth based home automation system using cell phones:

In Bluetooth based home automation system the home appliances are connected to the Arduino BT board at input output ports using relay. The program of Arduino BT board is based on high level interactive C language of microcontrollers; the connection is made via Bluetooth. The password protection is provided so only authorized user is allowed to access the appliances. The Bluetooth connection is established between Arduino BT board and phone for wireless communication In this system the python script is used and it can install on any of the Symbian OS environment, it is portable. One circuit is designed and implemented for receiving the feedback from the phone, which indicate the status of the device.

### 3. GSM based home automation system using cell phones:

Because of the mobile phone and GSM technology, the GSM based home automation is lure to research. The SMS based home automation, GPRS based home automation and dual tone multi frequency (DTMF) based home automation, these options we considered mainly for communication in GSM. The system use transducer which convert machine function into electrical signals which goes into microcontroller. The sensors of system convert the physical qualities like sound, temperature and humidity into some other quantity like voltage. The microcontroller analysis all signal and convert them into command to understand by GSM module. Select appropriate communication method among SMS, GPRS and DTFC based on the command which received GSM module

### 3.PROBLEMS IN CURRENT SYSTEMS:

Current theft detection systems (e.g., basic CCTV, manual guards, or standalone alarms) have key limitations that your Arduino-based solution addresses:

- **High Cost:** Traditional systems require expensive cameras, wiring, and professional installation, while yours uses affordable components .
- **No Real-Time Alerts:** CCTV records passively without immediate owner notification; guards may be absent. Your GSM module sends instant calls/SMS.
- **Wired Dependency:** Many rely on fixed cabling, limiting mobility. Your wireless GSM/WiFi design enables flexible placement.
- **Delayed Evidence Capture:** Motion recording often misses the event or lacks targeted thief focus. Your PIR-triggered camera starts exactly when needed.
- **No On-Site Deterrence:** Silent recording fails to scare intruders. Your buzzer/lights provide immediate audible/visual warnings.
- **Power Hungry:** Commercial systems need constant power outlets. Arduino's low-power mode supports battery/24/7 operation.
- **Complex Setup:** Requires IT expertise. Yours programs easily via Arduino IDE with basic C code.
- **Limited Scalability:** Hard to add features like lasers. Your modular design expands simply.
- **Poor Tamper Resistance:** Vulnerable to disabling. Enclosed Arduino/PIR setup resists casual sabotage.

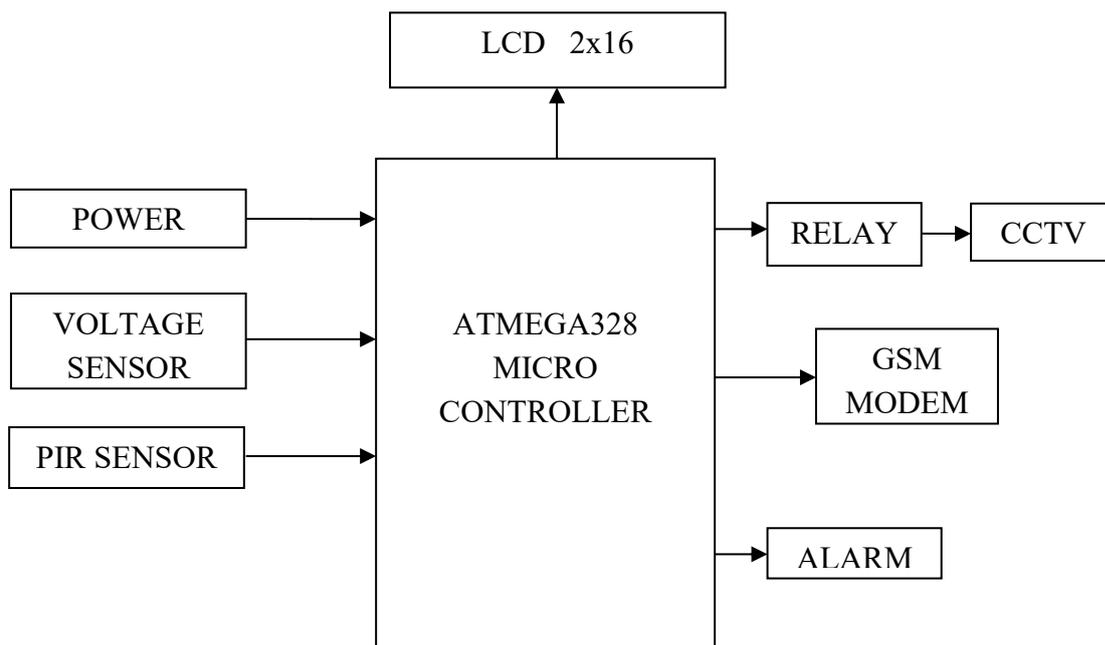
### 4.OBJECTIVES OF THE PROPOSED SYSTEM :

- The Arduino-based security system aims to achieve these key objectives:
- Develop a low-cost , easy-to-implement solution using Arduino UNO, PIR sensor, GSM module, buzzer, and motion camera for protecting valuables.
- PIR Sensor, real time motion detection at display tables/shelves to sense if there is an intruder approaching, making it look like the interactive display has mind of its own.
- The surveillance cameras are ready for instant use to deter intruders with on-site buzzer alarm and LED lights activation.
- The camera will take clear evidence of the thief when triggered and the video footage will be held in memory for easy identification.
- Can send instant wireless notifications (calls/SMS) via GSM module to the owner anytime from anywhere in the world.
- Ensure 24/7 reliable operation with low power consumption and tamper-resistant design.

## 5. PROPOSED METHOD

Theft from the strong rooms leads to a huge loss of financial and strategic value. So here is the project of low cost security system based on Arduino UNO (ATmega328) using PIR sensor, GSM, buzzer and motion camera for surveillance. This is a very inexpensive, yet very highly secure System (using Arduino UNO with Wi-Fi) that can be very quickly implemented for surveillance and protection of sensitive and high value items. The system is based on an ATmega328 (of the Arduino Uno), a PIR motion sensor, a GSM SIM module, a buzzer (a ringer similar to those found in old phones), and a motion tracking camera, for surveillance of items on tables and in shelves. If there is any motion close to the objects of value the PIR sensor sends a signal to the Arduino which activates two sequences. One is of an immediate alarm at the point of theft by activation of the buzzer and lights that signal to the owner or guardian that something is happening. The other sequence instructs the Arduino to initiate a sequence of photographs and videos of the intruder by means of the camera that retains the images on the memory. The GSM part of the circuit is used for sending calls and SMSs to the owner of the circuit all over the world. In the expanded version, laser security system has been added to it. The programming of this circuit is done through Arduino IDE with the help of the embedded C code which is uploaded to the Arduino board through serial communication. All the components (PIR, SIM, buzzer, camera) in the circuit are connected to the input and output pins of the Arduino board for processing the signals and confirmation of output. This project is about using the human motion sensor with Arduino in order to protect our properties from theft by making the system work with hardware and software tools 24/7 without any break. The system is easy to assemble and test, in order to protect the valuables we have at home from theft by detecting them, taking pictures, sending notifications.

## 6. BLOCK DIAGRAM:



## 7. MAIN COMPONENTS

- Arduino UNO (ATmega328 microcontroller)
- PIR Motion Sensor
- GSM Module (with SIM card)
- Buzzer (Ringer)
- Motion Camera (CCTV)
- Relays
- LCD

## 7.1 ARDUINO UNO (ATMEGA328 MICROCONTROLLER)



The Arduino UNO is an open-source microcontroller board featuring the ATmega328P 8-bit AVR microcontroller with 32KB flash memory, 2KB SRAM, and 1KB EEPROM. It operates at 16MHz via crystal oscillator and provides 14 digital I/O pins (6 PWM), 6 analog inputs, UART, SPI, and I2C interfaces for sensor/actuator connectivity. In this security system, it serves as the central controller—receiving PIR motion signals via interrupt (INT0), processing embedded C code from Arduino IDE, and simultaneously triggering the buzzer, camera recording, and GSM alerts. Power supply: 5V DC via USB/barrel jack with onboard regulator.

## 7.2 PIR MOTION SENSOR



The PIR (Passive Infrared) sensor detects human/heat motion by sensing infrared radiation changes in its field of view (typically 110° angle, 3-7m range). It outputs a digital HIGH signal (3.3V) when movement is detected, connecting to Arduino's interrupt pin (INT0) for instant response. In this security system, the PIR monitors valuables on tables/shelves, triggering Arduino upon intrusion to activate buzzer, camera recording, and GSM alerts simultaneously. Adjustable sensitivity (potentiometer) and delay time (0.3s-5min) optimize detection range/performance. Operating voltage: 3-15V DC; low power consumption.

## 7.3 GSM MODULE (WITH SIM CARD)



The GSM module is a wireless communication device that accepts a SIM card for global mobile network connectivity, enabling SMS and voice call transmission. It communicates with Arduino UNO via serial UART interface using AT commands. In this security system, when PIR sensor detects motion, Arduino sends commands to GSM module which immediately dials owner's phone number or sends SMS alert ("Theft detected!") worldwide. Requires active prepaid SIM with sufficient balance. Common models: SIM800L, SIM900 (1.8-4V operation, compact size). Key features include GPRS data capability (future IoT expansion), low power sleep mode, and antenna for reliable signal. Provides remote owner notification beyond local alarms.

## 7.4 BUZZER (RINGER)



The buzzer is an electromechanical or piezoelectric audio transducer that generates loud warning sounds when activated by Arduino's digital output (5V HIGH signal). It connects directly to a digital pin through a current-limiting resistor (220-1K $\Omega$ ) to prevent damage. In this security system, when PIR sensor detects motion, Arduino instantly triggers the buzzer to emit continuous piercing alarms (~1-3kHz tone), providing immediate on-site deterrence to scare intruders and alert nearby people.

## 7.5 RELAY MODULE



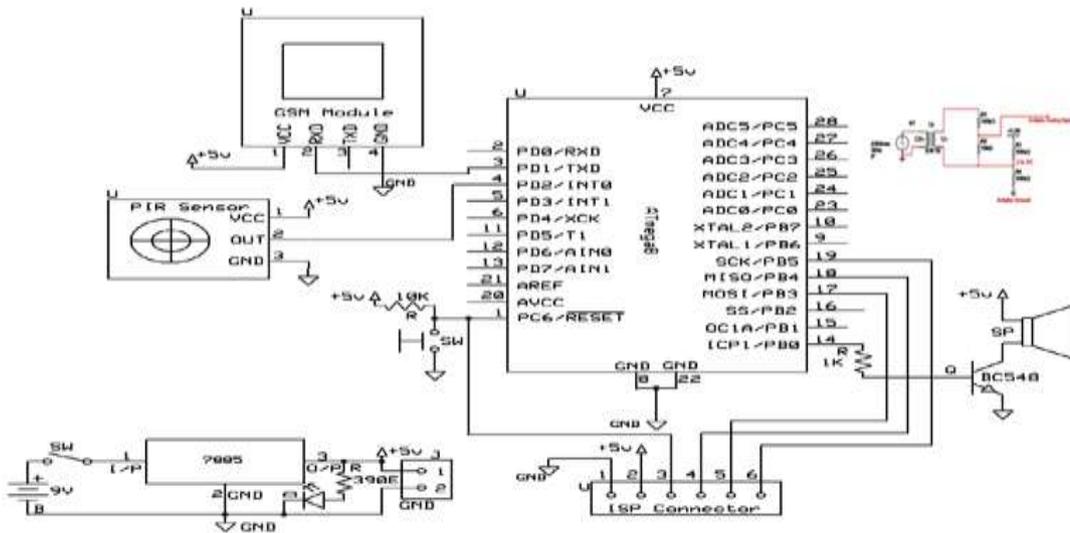
The 5V Relay Module is an electromechanical switch controlled by ESP32 GPIO pins (3.3V logic) to manage high-voltage AC/DC loads up to 10A/250VAC or 10A/30VDC. It features an opto-isolator for safe separation between low-voltage control circuitry and dangerous mains power, preventing back-EMF damage. Built-in freewheeling diode across the relay coil absorbs voltage spikes, while the transistor driver (e.g., ULN2003 or S8050) amplifies GPIO current for reliable coil activation.

## 7.6 LCD DISPLAY



The 16x2 LCD Display (HD44780 controller with I2C backpack) provides a compact local interface for real-time readings of voltage, current, power, energy, and theft status. It features 2 lines  $\times$  16 characters (5 $\times$ 8 pixel font), blue/white backlight, and operates on 5V with <20mA current draw via 4 data pins + power. Connected to ESP32 via I2C (SDA/SCL pins), it enables on-site verification without internet access, updating every second for instant anomaly feedback.

## 8. CIRCUIT DIAGRAM



## 9. HARDWARE IMPLEMENTATION

### 1. Prepare Power Supply

- Connect 230V AC to 12V 1A step-down transformer
- Wire bridge rectifier (4x 1N4007 diodes) + 1000μF capacitor filter
- Add 7812 regulator for 12V output, Arduino provides 5V regulation

### 2. Mount Arduino UNO

- Place Arduino UNO on breadboard/PCB base
- Connect 5V power supply adapter (2A recommended)
- Verify onboard LED lights up

### 3. Connect PIR Motion Sensor

- VCC → Arduino 5V
- GND → Arduino GND
- OUT → Arduino Pin 2 (INT0 interrupt pin)
- Adjust sensitivity potentiometer for 3-5m range

### 4. Wire Buzzer

- Buzzer positive → Arduino Pin 8 (through 220Ω resistor)
- Buzzer negative → Arduino GND
- Test with simple digitalWrite(HIGH)

### 5. Interface GSM Module

- Insert active SIM card with balance
- VCC → Arduino 5V, GND → GND
- TX → Arduino Pin 3 (RX), RX → Arduino Pin 4 (TX)
- Connect external antenna

### 6. Connect Motion Camera

- VCC → Arduino 5V, GND → GND
- Trigger pin → Arduino Pin 7
- SD card module for image storage

### 7. Final Assembly

- Organize wires with zip ties
- Mount PIR sensor facing protected valuables
- Enclose in tamper-proof plastic box
- Position GSM antenna externally

## 8. Testing

- Upload Arduino code via USB
- Walk in front of PIR → verify buzzer, camera trigger, SMS/call
- Check all three responses activate simultaneously

## 10. SOFTWARE IMPLEMENTATION

### 1. Install Arduino IDE

- Download and install latest Arduino IDE from official website
- Select Arduino UNO board from Tools → Board menu
- Install CH340/FTDI USB drivers for proper communication

### 2. Define Pin Assignments

- Assign PIR sensor to interrupt pin 2 (INT0)
- Buzzer to digital pin 8
- Camera trigger to digital pin 7
- GSM serial pins: TX=4, RX=3

### 3. Initialize Hardware

- Setup serial communication at 9600 baud for GSM module
- Configure all output pins as OUTPUT mode
- Attach interrupt service routine to PIR pin (RISING edge)

### 4. GSM Module Initialization

- Send AT command to check module response
- Set SMS text mode (AT+CMGF=1)
- Configure owner phone number for alerts

### 5. Interrupt Service Routine Setup

- Create function triggered by PIR motion detection
- Execute three simultaneous actions: buzzer, camera, GSM
- Add debounce timer to prevent false triggers

### 6. Main Program Loop

- Continuously monitor system status
- Handle GSM communication responses
- Implement low-power sleep modes for 24/7 operation

### 7. Code Upload Process

- Connect Arduino via USB cable
- Verify code compilation without errors
- Upload program and monitor serial output

### 8. Testing & Debugging

- Test each component individually first
- Verify simultaneous operation of all three responses
- Check Serial Monitor for GSM AT command responses
- Fine-tune PIR sensitivity and timing parameters

## 11. WORKING

- System remains in a Standby Mode and the PIR sensor is permanently scanning the protected area.
- Intruder enters PIR detection range (3-7m), sensor detects infrared/heat signature
- PIR sends HIGH signal to Arduino Pin 2 instantly through an analog output
- Arduino interrupt service routine executes within milliseconds
- Buzzer sounds strongly, camera is switched on and GSM sends message
- Buzzer sends continuous 85dB alarm + Arduino LEDs flash on site to scare away intruder
- Uses a Motion Camera to catch clear photos or videos of the thief and time-stamps the event and saves to SD card

- GSM module dials owner's phone + sends SMS "Theft detected!" worldwide
- Owner receives immediate notification for rapid response
- Alarm continues for 30 seconds then auto-resets to standby
- System ready for next detection, operates 24/7 continuously
- Provides triple protection: on-site deterrence, evidence capture, remote owner alert

## 12.ADVANTAGES

- Low Cost: Complete system under commercial alternatives
- Triple Protection System (Protection in three ways): On-site Buzzer Alarm - Camera footage of the whole incident - Owner SMS/call alerts to let you know something is happening to your car
- Wireless Global Alerts: GSM works worldwide without internet/WiFi dependency
- Real-time Response: <1ms interrupt detection ensures instant activation
- 24/7 Reliable Operation: Low power with tamper-proof enclosure design
- Easy Scalability: Expandable with laser sensors, multiple PIRs, DIY friendly

## 13.APPLICATIONS

- Home security systems
- Retail store protection
- Museum exhibit safeguarding
- Jewelry shop security
- Office equipment monitoring
- Small warehouse protection

## 14.CONCLUSION

A security system based on Arduino costs less than ₹5000 and can be used for real time theft protection by means of PIR sensor, alarm at the time of theft, camera footage and sending messages to the owner by mean of GSM. CCTV has its own set of limitations. This system provides instant protection, is on at all times, easy to set up and needs no expertise. It is very much useful for homes, shops and museums. This project gives a good practical example of using an embedded system and it is easily extendable to further features.

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