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DESIGN AND IMPLEMENTATION OF A PROXIMITY-ACTIVATED GUARD DOG SOUND SYSTEM WITH EMBEDDED GSM MODULE

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Abstract

In contemporary security management, the integration of automated deterrents and real-time notification systems is essential for effective property protection. This study presents the design and implementation of a Proximity-Activated Guard Dog Sound System with an Embedded GSM Module, an intelligent security solution that combines psychological deterrence with remote alerting capabilities. The system utilizes an Arduino microcontroller as the central processing unit, interfaced with a Passive Infrared (PIR) sensor for high-sensitivity motion detection. Upon detecting an unauthorized heat signature, the system executes a dual-action response: it triggers a DFPlayer Mini audio module to [redacted] broadcast high-decibel, realistic dog barking sounds through an external speaker, and simultaneously utilizes a SIM800L GSM module to transmit an instant SMS alert to the property owner's mobile device. Experimental results indicate that the system effectively differentiates between static environments and human-scale movement, providing a cost-effective alternative to maintaining live guard animals or expensive CCTV monitoring services. The inclusion of the GSM layer ensures that security breaches are communicated

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within seconds, regardless of the user's geographical location. This project demonstrates a scalable model for smart home security, offering a proactive approach to crime prevention through acoustic simulation and cellular communication.

Introduction

In an era characterized by rising urban populations and increasing security concerns, the protection of life and property has become a paramount priority. The busy lifestyle of people is leading to the necessity of controlling the devices at home remotely and increasing the necessity of keeping surveillance over their homes. In many areas of industry especially where there is need to protect certain goods or services electronic security based on the use of embedded processors are employed (Iyapo *et al.,* 2017). Traditional security measures, such as physical locks and passive surveillance cameras, often prove insufficient because they do not actively intervene during a security breach. This research tends to utilize the availability of GSM network and Dog Sound System in place of alarm. The new age of technology has redefined communication (Tazkia, 2024), most people nowadays have access to mobile phones and thus the world indeed has become a global village. At any given moment, any particular individual can be contacted with the mobile phone. But the application of mobile phone cannot just be restricted to sending SMS or starting conversations. New innovations and ideas can be generated from it that can further enhance its capabilities. Technologies such as Infra-red, Bluetooth. The primary deterrent for most casual intruders is the threat of detection or physical confrontation. Also, research has shown that the sound of an aggressive, large-breed dog is one of the most effective psychological barriers against unauthorized entry (Hannah *et al,.* 2017). However, owning a live animal involves feeding, training, and healthcare. The Proximity-Activated Guard Dog Sound System with GSM module offers a sophisticated alternative by utilizing electronic sensing and telecommunication technology to simulate a high-alert security environment. This is done by providing a system that can both deter an intruder and provide immediate notification to the property owner.

The Proximity-Activated Guard Dog Sound System with Embedded GSM Module represents a fusion of sensor technology, digital audio processing, and cellular communication. The project is inspired by the natural effectiveness of a guard dog, which serves as one of the oldest and most reliable forms of security. However, the costs and responsibilities associated with maintaining a live animal make it impractical for many. This project replicates that deterrent effect through a "virtual" medium, using an Arduino-controlled environment to simulate the presence of a canine guardian. At the heart of this system is the PIR (Passive Infrared) Sensor, which acts as the "eyes" of the device,

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detecting the heat signatures of moving objects. Unlike continuous alarms, this system is reactive and intelligent. By integrating a DFPlayer Mini MP3 module, the system provides an immediate acoustic response barking which creates a psychological barrier for the intruder.

PROBLEM STATEMENT

Traditional alarm systems often rely on loud sirens which, while effective at alerting neighbors, do not necessarily "scare" an intruder in the same way a biological threat does. Furthermore, many standalone alarms lack a feedback mechanism to alert the owner if they are away from the premises. This project addresses: The high cost and responsibility of maintaining live guard dogs, the lack of real-time remote notification in basic localized alarm systems and the need for a deterrent that provides a psychological "threat" rather than just a noise.

OBJECTIVES OF THE STUDY

In order to achieve the main goal of this research, the following objectives will be employed:

i. To design a sensing circuit capable of detecting human proximity.
ii. To implement a high-quality audio playback system that triggers specific "warning" and "aggressive" barks based on distance.
iii. To integrate a SIM800L GSM module to send SMS alerts to a programmed number upon activation.

REVIEW OF RELATED LITERATURE

Traditional security systems often rely on silent alerts or generic sirens. However, research into "Active Deterrence" suggests that specific, recognizable sounds such as a barking dog are more effective at inducing a "flight" response in intruders. Burglars generally seek unoccupied targets; a barking dog serves as a strong indicator of both occupancy and a physical threat (Sophia et al., 2004). Literature in acoustics highlights that sudden, high-decibel natural sounds cause immediate disorientation, buying time for the security system to send notifications.

Nicholas *et al.,* (2019), constructed an intruder detector system using an ATmega8 microcontroller, system connected to a GSM module with SIM (subscriber identification module) from a network provider. Light dependent resistor (LDR) sensor is connected to a microcontroller unit, GSM module and other electronic devices which detects any intruder in a classified area and then activates the alarm system and sends out text

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message notifications to the house owner specifying the location and time of intrusion to the programmed phone number of the house owner. However, the system is not reactive and intelligent.

Hussaini *et al.,* (2025), designed a remote home security system that uses cheap hardware and software such as Arduino boards, passive infrared sensor, highly sensitive camera, GSM modem, Buzzer alarm, SD card, jumper wire and a 9v battery among others to collect information from PIR sensors, process the information and send SMS to corresponding GSM mobile phone number of the homeowner. However, the system does not incorporate an immediate acoustic response barking which creates a psychological barrier for the intruder.

Aluko *et al.,* (2022), designed a security system that triggers an alarm upon the detection of an intruder and sends alerts via a SMS to whoever is in charge or security personnel. The system integrates sensor via a microcontroller such as Passive Infrared (PIR) sensor to detect an intruder and sound an initial warning for 30 seconds while awaiting the user response (system deactivation) in case of false intruder. Upon no response clearly indicates true intruder and the system eventually trigger an alarm and sends an (SMS) Short Message Service alert (predefined message which is embedded within microcontroller) to the user or security personnel through GSM module.

Ikpenyi *et al.,* (2022), developed a GSM based home security alert system, that will be fit for identifying an interloper, send ready message to mortgage holder, and initiate a bell caution. The security ready framework has been effectively built utilizing a uninvolved infrared (PIR) sensor. Arduino microcontroller was utilized to interface between the PIR sensor (input) and the GSM/buzzer (yield) gadgets. The PIR sensor was proposed to recognize the nearness of human and convert the identified sign into electrical voltage signal. The arduino uno was to process the flag and send directions to GSM module and buzzer, at the same time recognize the nearness of human and convert the identified sign into electrical voltage signal. The arduino uno was to process the flag and send directions to GSM module and buzzer, at the same time.

Srieesh *et al.,* (2018), proposed system that provides the user with complete control of the interface which is based on mobile application. As home security system which provides 360-degree presence of human sensor which will detect the presence of any intruder in a suitable range, detects the motion and the GSM module gets invoked. This system provides the extra attachment of other devices sensors in a single shield. Design system reduces the time complexity of connection and transmitting of information to the corresponding user and provide direct message transmission using the GSM module to the user regarding the fraud detection.

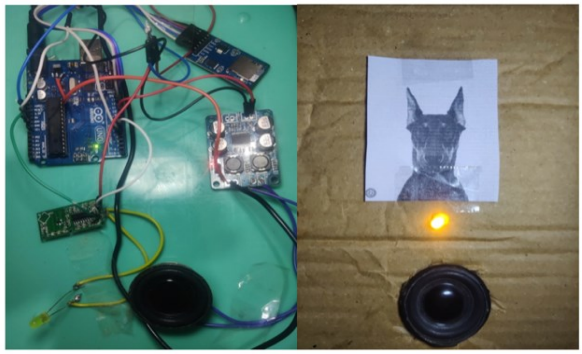
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Steve *et al.,* (2024), developed an alarm system with GSM Technology and RFID Integration, include using GSM technology to monitor and transmit warnings when unusual motion is detected. The RFID component enables the system to distinguish between permitted and illegal entry. The GSM module is essential to this pursuit, as it allows for remote homeowner alerts. The system's programming, which merges the GSM and RFID components, is critical to the project's operation. Finally, the SMS notification capability is required for distant alerts, making it an essential component of the alarm system. The Alarm System with GSM Technology and RFID Integration is a robust and adaptable security system with essential motion detection and alerting feature.

Anaswara *et al.,* (2025), developed an automatic dog barking system based on microcontroller and ESP32-CAM, an intelligent security system that employs face recognition to detect people. When somebody comes close, that image is captured by the ESP32-CAM and matched with the stored database. If it is a familiar person, an LED flashes for granting authorized access. If it is not known, an alarm of dog barking is activated by the system to inform homeowners. This system offers an affordable and automated solution for home security improvement.

Methodology

Design and Implementation of a Proximity-Activated Guard Dog Sound System with embedded GSM module is meant to improve home security through the discouragement of intruders and sending a dog barking sound. The system sends an SMS notification to a smartphone of the owner. Upon detection of a human, a signal is sent to the Arduino using serial communication. The Arduino is interfaced with a DFPlayer Mini sound module and a speaker as shown in figure 1 below, plays pre-recorded dog barking sound to mimic the presence of a guard dog. The system offers an easy and inexpensive means of deterring intruders.



Assembled prototype

Figure 1: Prototype of the System

SIM800 GSM Module

SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. Module can be used to accomplish almost anything a normal cell phone can; SMS text messages,

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make or receive phone calls, connecting to the internet through GPRS, TCP/IP, and more. It can communicate with microcontroller via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands). This module support software power on and reset. The GPRS is configured and controlled via its UART using simple AT commands. Figure 8 shows the GSM module used for this work.



Figure 2: SIM800L GSM Module Pinout, Datasheet, Equivalent, Circuit, and Specifications (Aditi *et al.*, 2023)



Figure 3: High-quality audio playback system that triggers specific "warning" and "aggressive" barks based on distance.

From figure 3 above; Dog barking control devices 2 pack auto dog anti barking devices with 4 modes (High-quality audio playback system that triggers specific), 50ft bark box dog bark deterrent devices for indoor outdoor dogs. No manual intervention is needed the device responds instantly, making it a hassle-free solution for excessive barking, whether used indoors or outdoors.

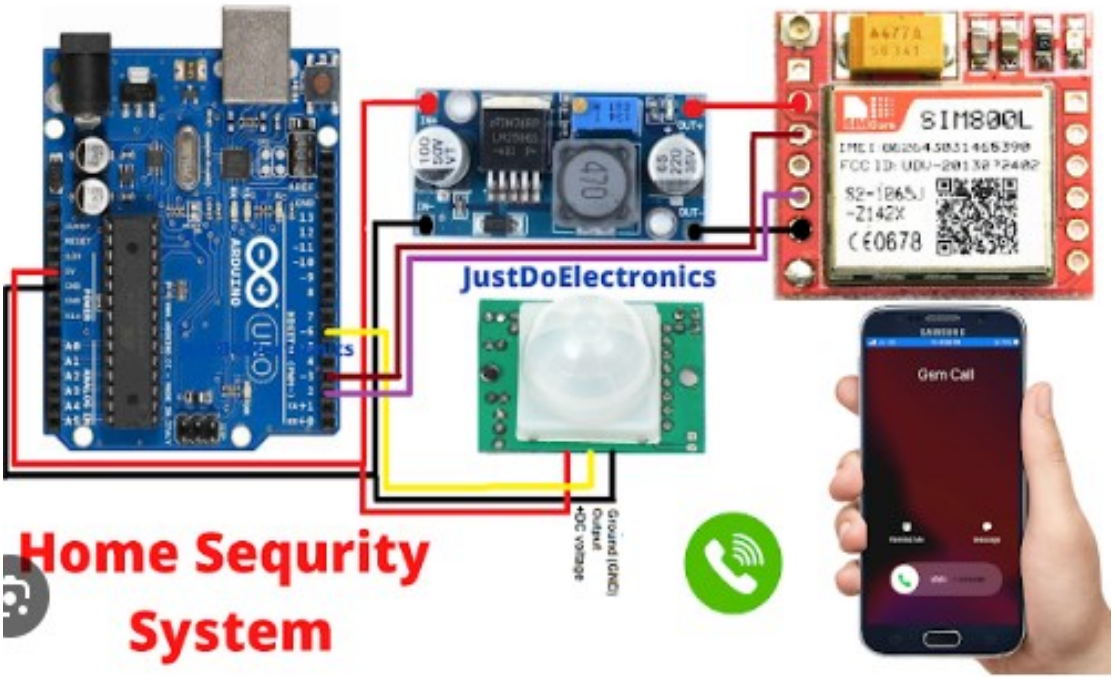


Figure 4: Circuit diagram of Dog Barking Security Alarm using Arduino, PIR Sensor, Dog Barking Sound Module and GSM Module.

Figure 4 shows the circuit design of the proposed system with GSM module. It consists of microcontroller which acts as the **"brain"** of the sensing circuit. Microcontroller is designed to do one thing very well: receive inputs and control outputs. The microcontroller constantly monitors the voltage on its Digital Input Pins (connected to your PIR). It also has the GSM module which consisted of the SIM800 module as the central core. As input to the module is a switch and connector for either hardware powering of the module or software-based powering. The module also consisted of a SIM card holder for the attachment of the desired network operator SIM card. The design also included a microphone and earphone jack for audio or voice transmission and reception. The module connects to the microcontroller unit via the RX and TX pin which are dedicated for Asynchronous serial data process. The entire module is powered from a 4.2V

power regulator and therefor needed voltage translator built out of transistor for smooth interchange of data.

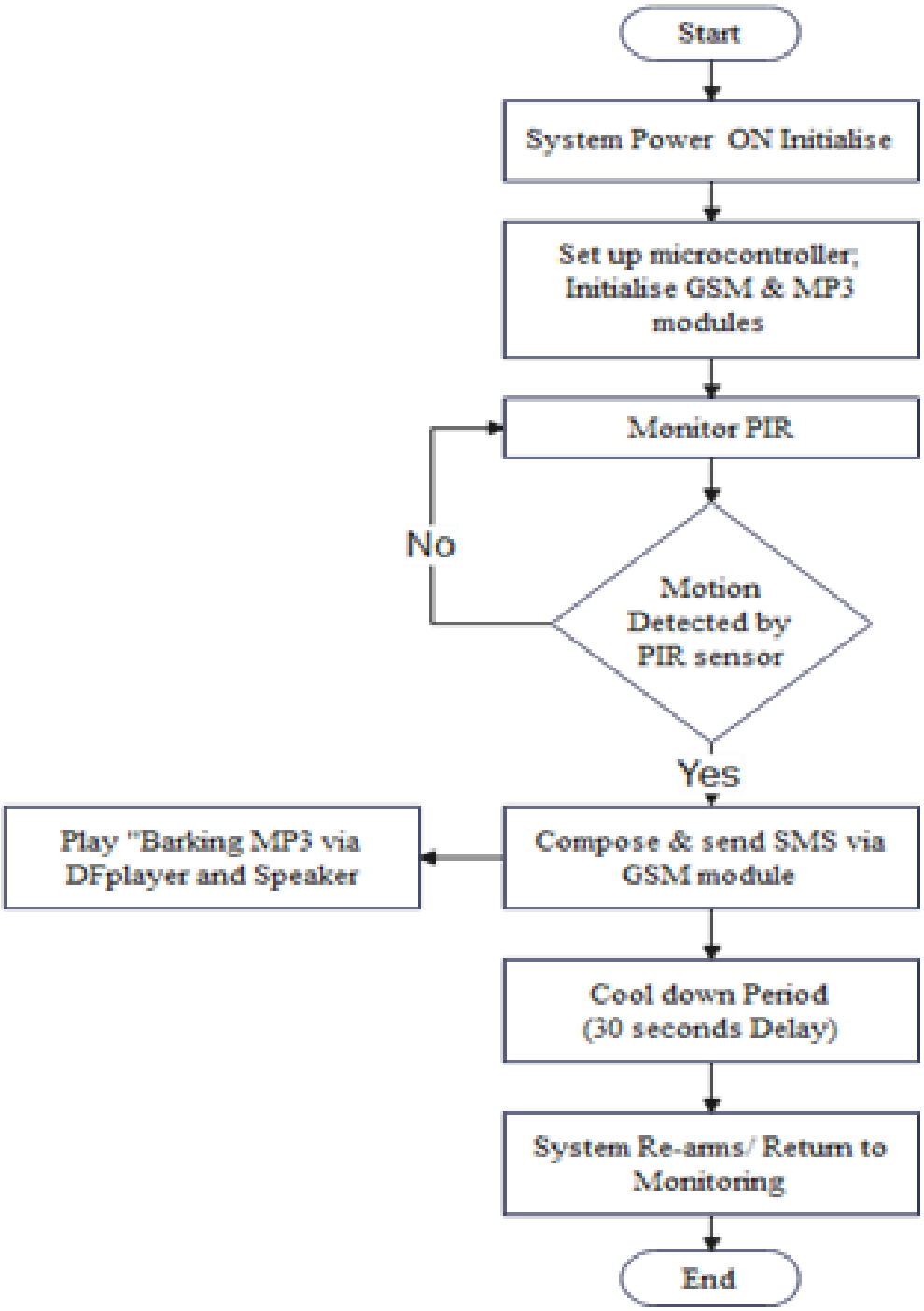


Figure 5: Showing the flow specialized type of modem chart for the program in the embedded processor.

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Passive Infrared Sensor (Motion Sensor)

A motion detector is contains a motion sensor and is either incorporated with or connected to other devices that alert the user of the pre-sense of body motion. An electronic motion detector contains a motion sensor that transforms the detection of motion into an electric signal. The motion sensor used for this work is the Pyroelectric Infrared PIR Motion Sensor Detector Module shown in Figure 6.The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin. Its special features include Single bit output Small size which makes it easy to conceal, Compatible with all Parallax microcontrollers 3.3V and 5V and operation with <100uA current draw. The Pyroelectric devices, such as the PIR sensor shown below, have elements made of a crystalline material that generates an electric charge when exposed to infrared radiation. The changes in the amount of infrared striking the element change the voltages generated, which are measured by an on-board amplifier. The device contains a special filter called a Fresnel lens, which focuses the infrared signals onto the element. As the ambient infrared signals change rapidly, the on-board amplifier trips the output to indicate motion.



Figure 6: Showing the infrared sensor used for this work. (Poojit *et al.,* 2014)

System Description

The project was design to provide global access to the system for the security using extensive

GSM technology and Dog sound system for communication purposes and security alertness; and microcontroller for device control. The highlights of the system are the long range of communication and robust coordinating software with a data base containing information about the user (client) mobile phone number. The system begins in a standby mode, the PIR sensor constantly monitors its field of view for changes in infrared radiation. When an intruder moves within the detection zone, the sensor detects the heat pressure of an intruder, the PIR sensor converts the physical movement of an intruder

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into an electrical signal, sending a Digital HIGH (3.3V - 5V) pulse to the microcontroller. The Microcontroller Unit (MCU) which acts as the processing unit of the system, receives the HIGH signal from the PIR sensor and executes a pre-programmed logic sequence: It validate the signal to avoid false alarm from small movements. Once validated, the MCU simultaneously initiates the communication protocol for the GSM module and the playback command for the audio module. The MCU sends a command through UART (Serial communication) to the DFPlayer Mini which fetches a high-fidelity mp3 file of an aggressive barking dog from the microSD card. The low-level audio signal is sent to a power amplifier, which boosts the signal to drive a high-decibel speaker. The loud sudden sound creates the illusion of a territorial guard dog, usually causing the intruder to flee immediately. While the sound is playing, the system ensures that the occupant of the house is informed regardless of the location, the MCU sends AT Commands to the SIM800L GSM Module which in turn instructs the module to send an SMS text message to the occupant's phone. Optionally, the system can place a direct phone call. If the occupant picks up, they can hear the barking and ambient noise through a connected microphone to verify the threat.

SIM800 GSM Module

The GSM module used for this work is the SIM800 GSM/GPRS module from SIMCOM. It is an ultra-compact and reliable wireless module with minimum system configuration based on a 0 Quad-band GSM/GPRS technology making it suitable for use in any part of the world. It can communicate with microcontroller via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands). This module support software power on and reset. The GPRS is configured and controlled via its UART using simple AT commands. Figure 2 shows the GSM module used for this work.

RESULTS AND DISCUSSION

The testing instrument used for examining logical signal testing and troubleshooting application in the course of this research were: digital multimeter, logic probe and oscilloscope. The test result shows that both the Dog sound system and the motion sensor perform adequately. The hardware system was properly tested because the software cannot work without the proper functioning of the hardware. The testing of the entire circuit was carried out in stages:

Each of the components was first tested using the multimeter in order to check for their state of performance and accurate values. In the connection, each component on the PCB was then tested. This was done in other to carry out the continuity, which is meant for

proper connection of the circuit and to detect any wrong connection. The sensory unit circuitry was tested to ascertain the degree of sensitivity as expected.

Conclusion

The Proximity-Activated Guard Dog Sound System successfully demonstrates the integration of sensor technology, audio processing, and cellular communication to create a proactive security solution. By combining the immediate psychological deterrent of a localized "guard dog" with the remote notification capabilities of a GSM module, the system bridges the gap between passive alarms and expensive monitored security services. The ultrasonic logic effectively filtered out minor environmental noise to maintain an accurate detection zone, ensuring the system only triggers when a significant breach occurs.

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