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Detection of Hidden Cameras

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ABSTRACT
In today's world, security and privacy concerns have become a major issue, particularly regarding hidden cameras in sensitive areas like girls' washrooms, shopping malls, and dressing rooms. Numerous cases of blackmailing and privacy breaches have been reported due to unauthorized recordings from these hidden cameras. To address this concern, we propose a Hidden Camera Detection System that can detect hidden cameras and alert users both visually and audibly. This device uses an ESP32 microcontroller, an LCD display, a buzzer, and an IoT-enabled notification system to detect hidden cameras and notify authorities or concerned individuals.

Keywords: Hidden camera detection, ESP32 MC, IoT Notification system, Surveillance, Real time Alerts

1. INTRODUCTION

With the rise in technology, privacy violations have also increased, making it imperative to develop an efficient solution to detect hidden surveillance devices in private spaces. Many victims have been exploited due to secret recordings in places like public washrooms, trial rooms, and hotel rooms. Hidden cameras have become more advanced and smaller in size, making them increasingly difficult to detect with the naked eye. Conventional detection methods, such as manual scanning, are often inefficient, timeconsuming, and unreliable in larger or more complex environments.

To address this growing concern, our project aims to create a portable hidden camera detection system that alerts users when a hidden camera is detected. The device displays the detection message on an LCD screen, triggers a buzzer, and sends an alert message via IoT to a designated mobile number, such as law enforcement officers. The integration of IoT enables real-time monitoring and instant alerts, making it easier to take immediate action against privacy breaches. This system is designed to be user-friendly, compact, and effective in a variety of environments, such as shopping malls, hotel rooms, changing rooms, and public restrooms.

By leveraging hardware components such as the ESP32 microcontroller, LCD display, and a buzzer, the system ensures accurate detection and rapid response. Additionally, the use of a laptop for hidden camera detection enhances the system's efficiency by utilizing specialized detection algorithms. The implementation of this project will significantly improve privacy protection and help prevent unauthorized surveillance in public and private spaces.

2. LITERATURE REVIEW

The increasing threat of hidden surveillance devices in private spaces has been widely studied in recent years, with researchers and security experts exploring various methods for detecting and mitigating

unauthorized surveillance. The literature on hidden camera detection covers a range of technologies, including infrared detection, radio frequency (RF) scanning, electromagnetic signal detection, and AIbased image processing.

2.1 AI and Image Processing-Based Detection

Recent advancements in artificial intelligence (AI) and deep learning have enabled more sophisticated image-based detection systems. Studies by Zhao et al. (2021) demonstrate how convolutional neural networks (CNNs) can identify hidden camera lenses based on image patterns and reflections. AI-based detection is highly accurate, but it requires: High computational power, making it unsuitable for real-time portable solutions. Extensive training datasets, which may limit effectiveness in detecting newly designed hidden cameras.

2.2 IoT and Real-Time Alerting Systems

The integration of IoT (Internet of Things) technology into security applications has gained attention in recent research. A study by Singh and Gupta (2020) explored the use of IoTbased security devices that can send real- time alerts when a hidden camera is detected. Their work emphasized the importance of real-time communication between security devices and mobile applications, which significantly enhances the response time for law enforcement or security personnel. However, most existing IoT-based solutions lack: Hardware integration with portable devices for easy deployment in public places. User-friendly implementations, as many require complex configurations.

The proposed Hidden Camera Detection System fills this gap by combining multiple detection approaches into a compact, automated device with real-time IoT alerts. By integrating an ESP32 microcontroller, an LCD display, a buzzer, and a laptop-based detection program, the system ensures:

Efficient hidden camera detection using advanced scanning algorithms. Automated alerts via an IoT platform to notify authorities. A portable, user-friendly solution that can be deployed in public spaces. Thus, this project builds upon previous research and overcomes existing challenges by offering a comprehensive, real- time hidden camera detection system that enhances privacy and security in public and private areas.

3. EXISTING METHOD

Currently, hidden camera detection is carried out using conventional methods like infrared (IR) detection, radio frequency (RF) scanning, smartphone applications, and manual inspection. IR detection works by reflecting light off camera lenses but is ineffective in bright lighting and requires manual scanning. RF detection scans for wireless signals but fails to identify offline cameras and often gives false alerts due to interference from other electronic devices. Smartphone apps claim to detect magnetic fields or use reflections but are generally inaccurate and unsuitable for wide-area scanning. Manual inspection is highly time- consuming, subjective, and not practical for large public areas. These methods lack automation, precision, and real-time alert capabilities. As a result, they are not reliable for ensuring modern- day privacy and security needs in sensitive areas.

3.1 Problems in Existing System

- Lack of automation **:** Most current hidden camera detection methods require manual operation.
- Delayed or no alerts **:** Traditional methods do not offer real-time alerts. Even if a hidden camera is detected, there's no automatic system to notify the user or authorities immediately.
- Low accuracy and high dependency on manual efforts **:** Existing methods often depend on the user's skill and effort.

4. PROPOSED SOLUTION

The proposed hidden camera detection system provides an automated and real-time solution to identify hidden surveillance devices. It uses an ESP32 microcontroller, a 16×2 LCD with I2C module, a buzzer, push button, and USB 2.0 to TTL converter. A laptop runs a detection program using its camera and sends alerts to the ESP32 when a hidden camera is found. The system then activates the buzzer, displays a "Cam Detected" message on the LCD, and sends a real-time notification to a registered mobile number via IoT. This compact and user-friendly device is ideal for securing sensitive areas like washrooms, hotel rooms, malls, and dressing rooms.

4.1 Features of the Proposed System

Real-Time Alerts: Sends instant notifications via IoT to a pre-registered mobile number.

Dual Alert System: Visual Alert-A 16×2 LCD displays "Camera Detected" when a hidden camera is found and also Auditory Alert-A buzzer sounds to quickly draw attention.

User-Friendly Interface: Clear visual and audio feedback for easy understanding.

IoT Integration: Connects with cloud-based services or apps to send SMS alerts to designated contacts (e.g., police, security).

Cost-Effective Setup: Utilizes easily available components like ESP32, LCD, buzzer, and USB 2.0 to TTL converter keeping the cost low.

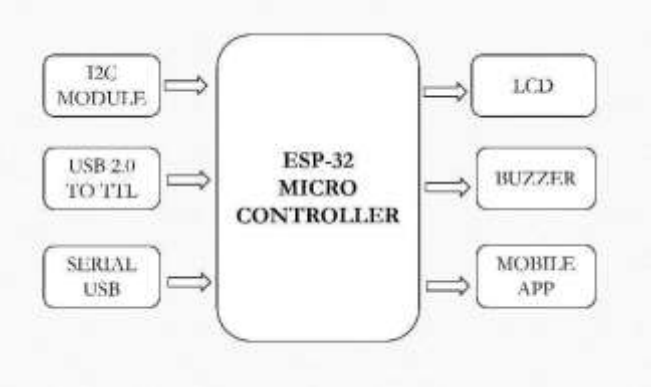


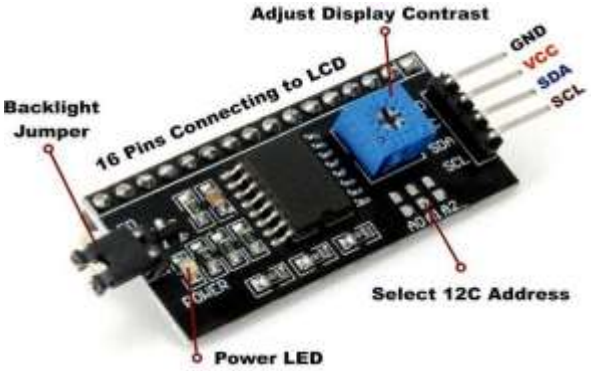
Fig.4.1.1: Block Diagram

5. HARDWARE COMPONENTS

5.1 ESP 32 - MICRO CONTROLLER

ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. Built-in Wi-Fi and Bluetooth capabilities. Basic is a cost-effective entrylevel main controller for IoT applications.

5.2 I2C MODULE



I2C is commonly used with sensors, displays, and memory devices in microcontrollers, Arduino boards, and other electronic projects. We are used for display purpose. I2C protocol involves using 2 lines to send and receive data. The I2C module converts the signals from the controller into commands for the LCD. The LCD has 16*2 cells that can display characters or symbol.

5.3 16x2 LCD DISPLAY

The 16x2 LCD display is a widely used alphanumeric display module that can show 16 characters per row across 2 rows. It operates using the Hitachi HD44780 controller and supports both 4-bit and 8-bit parallel communication with microcontrollers like Arduino. This display is ideal for embedded systems, providing a simple and efficient way to visualize sensor data and messages.

5.4 BUZZER

It generates sound by vibration of piezoelectric element by applying electricity. In our project we are using this as high alert indication for camera detection.

5.5 USB 2.0 TO TTL

A USB-to-TTL (Transistor-Transistor Logic) driver, also known as a USB-to-serial converter or USB-to-TTL serial adapter. It is a device that converts a USB signal to a TTL serial signal. Converts USB signal to TTL serial signal(typically 3.3V to 5V).

5.6 USB CABLE

A USB cable, short for Universal Serial Bus. It is a common type of cable used to connect electronic components to computers or other digital devices. It enables data transfer and power supply between devices, making it an essential tool in today's interconnected world.

6. SOFTWARE

6.1 Anaconda Prompt

Step-1: Download the Anaconda Installer for operating system.

Step-2: Install Required Libraries and Run Detection Code, Use Anaconda Prompt to install libraries like opencv,

numpy

Step-3: Run camera detection code.

6.2 For Getting the SMS

Once a hidden camera is detected, the app sends an SMS alert along with the current GPS location to a pre- registered mobile number, such as security personnel or police. Additionally, the app communicates with an ESP32 microcontroller via Bluetooth or Wi-Fi.

7. ADVANTAGES

- Enhanced Detection Accuracy
- Portability and User-Friendly Design
- Adaptability to Different Environments
- Privacy and Legal Compliance
- Versatile Application Scenarios
- Quick Deployment and Setup

- Cost-Effective Solution Detection Capabilities.

8. APPLICATIONS

- Personal Security
- Public Spaces
- Travel Safety
- Workplaces
- Hospitality Industry
- Event Venues
- Educational Institutions
- Business Meetings

9. EXPERIMENTAL RESULTS

The result obtained after completion the project is whenever the system then activates the buzzer, displays a "Camera Detected" message on the LCD, and sends a real-time notification to a registered mobile number via IoT.

10. FUTURE SCOPE

1. Portable Version: Developing a battery-Operated Version for enhanced mobility.
2. SmartPhone Integration: Creating a dedicated mobile app for easier monitoring and control.
3. Advanced AI-Based Detection: Implementing machine learning to improve detection accuracy.
4. Wider Frequency Detection: Expanding the system to detect different types of hidden surveillance devices beyond traditional cameras.

11. CONCLUSION

The creation of a portable hidden camera detector for women's safety directly responds to the growing demands for effective countermeasures against concealed cameras as well as privacy infringements. Compared to other approaches, this system offers numerous benefits and provides a reliable and easy-touse way to locate hidden cameras in a variety of environments.

Through the utilization of advanced detection technologies such as infrared analysis, visual inspection, and RF signal detection, the suggested system greatly improves the precision and stability of hidden camera identification. Its lightweight and user-friendly design enables people—women in particular—to carry and use the detector with ease whenever they need to protect their privacy.

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