


# The Design Of Perimeter Intrusion Detection System (PIDS) Surveillance Alarm Using USB Webcam And Artificial Intelligence Based On Web And Telegram Bot At Medan Aviation Polytechnic

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Article Info	ABSTRACT
<p><b>Keywords:</b> USB Webcam, Telegram, Web, Artificial Intelligence (AI), PIDS</p>	<p>Medan Aviation Polytechnic is a civil service college under the auspices of the Ministry of Transportation, especially in the air dimension. Medan Aviation Polytechnic is equipped with various complete educational facilities. However, security issues arise when cadets try to exploit vulnerabilities in the area to escape the campus. The purpose of PIDS is to detect and provide early warning of infiltration attempts in the campus area. This system is designed to integrate with various technology components such as the web and telegram bots as direct notifications and warnings to security officers, thereby increasing the security of Medan Aviation Polytechnic cadets. The method used in this research is by conducting research design, tool design, providing tool components and conducting system testing when the tool as a whole has been completed. The results of this study indicate that the system runs according to the desired design, where notifications are made with documentation in the form of camera portrait images and live streaming with a USB Webcam integrated with Artificial Intelligence (AI). If there is movement detected, it will send the portrait results to Telegram and issue an alarm on the buzzer and live streaming can be accessed on the available website.</p>
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## INTRODUCTION

Along with the advancement of technology, various modern security systems have been developed to improve surveillance and protection in the campus environment. One technological solution to overcome this problem is to build a Perimeter Intrusion Detection System (PIDS). PIDS is a system designed to detect and prevent intrusion into protected areas. In the context of dormitory surveillance, this system is very important to ensure security and prevent the escape of cadets. However, many conventional PIDS systems still use traditional technology with limitations in terms of flexibility and accuracy. Along with technological advances, especially in the field of artificial intelligence (AI), surveillance systems can now be improved by integrating USB webcams and AI technology that can detect human presence more accurately.

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The web-based system implementation allows easy access and management from various internet-connected devices. Users can monitor activity and receive notifications in real-time through an intuitive web interface. In addition, integration with Telegram bots provides additional convenience by providing notifications directly to the user's mobile device. These Telegram bots can be configured to provide instant alerts when an intrusion is detected, allowing for quick response and more effective preventive measures.

By combining USB webcam technology, artificial intelligence, web-based platform, and Telegram bot, the designed PIDS system has the potential to significantly improve dorm security. This system is not only a more sophisticated and accurate solution in detecting escape attempts, but also provides flexibility and ease in managing and responding to security incidents. Therefore, the development and implementation of this system is very relevant and important to answer the security challenges in today's dorm environment.

### Literature Review

#### Perimeter Intrusion Detection System(PIDS)

Perimeter Intrusion Detection System or PIDS is a device system that can detect the presence of intruders who try to penetrate the physical boundaries of property, buildings or other security areas. How PIDS works is that it includes physical sensors, electronic sensors. The goal is to protect the area from unauthorized access and potential threats in real time. The benefits of PIDS are:

1. Detect intruders at an early stage
2. Improve security quality
3. Save long-term fixed costs.

PIDS can operate independently or as part of a larger integrated security system that includes access control, alarm systems, and other security technologies. Therefore, PIDS is an important part of efforts to maintain security in industrial, government, military and commercial facilities.

#### Raspberry Pi 4 And ESP 32

Raspberry Pi is a single board computer (Single Board Circuit/SBC) that is the size of a credit card (Hakim, 2013). Raspberry Pi usually has a processor, RAM, microSD card slot for storing operating systems and data, HDMI port for video output, USB port for connecting additional input/output devices and GPIO (General Purpose Input Output) port that allows it to interact with various sensors, motors, and other electronic devices.



Figure 1. Raspberry Pi 4

ESP 32 is a series of microcontrollers developed by Espressid Systems, which is integrated with dual-mode Wi-Fi and Bluetooth so that it is very supportive for creating Internet of Things applications.



Figure 2. ESP 32

### Logitech C270 HD USB Webcam

Webcams are more commonly used on desktops and are used to record live social media broadcasts, make video calls, or simply take photos of your desktop. This system uses the Logitech C270 with a camera resolution of up to 3.0 megapixels and a video output resolution of up to 720p (1280 x 720 pixels), as well as a microphone with a USB 2.0 port.



Figure 3. Logitech C270  
HD USB Webcam

### Telegram

Telegram is a cloud-based messaging app that emphasizes speed and security. The app is designed to make it easy for users to send text, audio, video, images, and stickers securely. Telegram was developed by the Russian-based Telegram FZ LLC and Telegram Messenger Inc. Telegram Bot is a special account on Telegram designed to handle messages automatically. Users can interact with the bot by sending commands via private or group messages. This account serves as an interface for the code running on the server.

### Buzzer

Buzzer is an electronic component that produces sound vibrations in the form of sound waves. This component is often used because of its very low power consumption. The working principle of the buzzer is to convert electrical energy into sound that can be heard

by humans when an electric current flows through it. The type of buzzer that is often used is the piezoelectric buzzer, which operates at a voltage of 3 to 12 volts DC. The general function of a buzzer is as a component that produces output in the form of a beep sound and is usually used as an alarm, sound indicator and timer.



Figure 4. Buzzer

## SOFTWARE.

### Python

*Python* plays a vital role in making CCTV by providing tools and development to implement advanced features like motion detection, image processing and integration with other systems. Python uses OpenCV (Open Source Computer Vision Library) to perform object recognition, face recognition and gesture recognition.



Figure 5. Python



Figure 6. Visual Studio Code

### Visual Studio Code

Visual Studio Code (VS Code) is an open-source code editor developed by Microsoft to support software development in multiple programming languages. VS Code provides a lightweight yet powerful development environment with advanced features such as IntelliSense for intelligent code completion, built-in debugging, and Git version control.

### XAMPP

In web development, XAMPP makes it easier to test and debug websites and web applications more efficiently. Developers can install and run a web server on their local computer, allowing them to test the functionality of a website without the need for an actual online server. Additionally, XAMPP is often used for educational purposes as it provides an ideal environment for beginners to learn the basics of web development. With features such

as an easy-to-use control panel and support for multiple operating systems, XAMPP remains a popular tool among web developers and IT educators.



Figure 7. XAMPP

## METHOD

The research method applied is Research and Development (R&D), which is chosen because this method aims to produce certain products and test the results of these products. This research will produce a Perimeter Intrusion Detection System tool based on Raspberry Pi. The initial step in making it is collecting data and making a block diagram as a general description of the tool circuit. Here is a block diagram of the design:

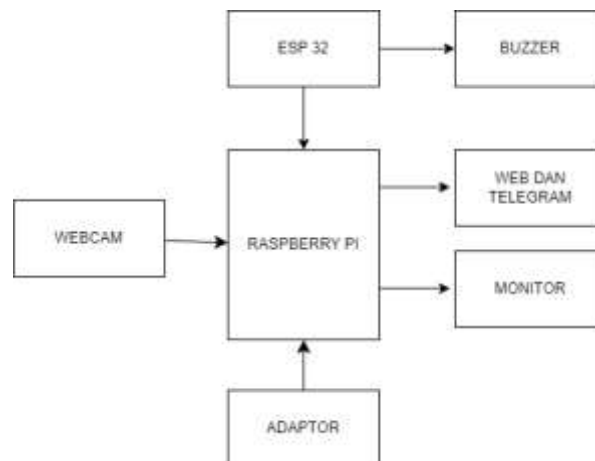


Figure 8. Tool Design Block Diagram

The explanation of each block is as follows:

1. USB webcam records all movements around the perimeter
2. ESP32 as the control center and the output is in the form of a buzzer.
3. Raspberry Pi 4 as the input controller center in the form of a USB Webcam, Adapter and ESP32 and output in the form of WEB, Telegram and monitor.
  - a) *Wifi/Hotspot* connected to Raspberry Pi 4, the wifi/hostpot device can be a modem access point or a smartphone hotspot.
  - b) WEB as a means of live streaming.
  - c) Telegram application to get notifications in the form of screenshots.
4. *Buzzer* useful as an alarm.
5. The adapter is useful as a power supply in the design
6. Monitor to generate images from WEB results

## RESULT

### Research Results

The following is a picture of the entire series of tools that have been made, it can be seen from the following picture.



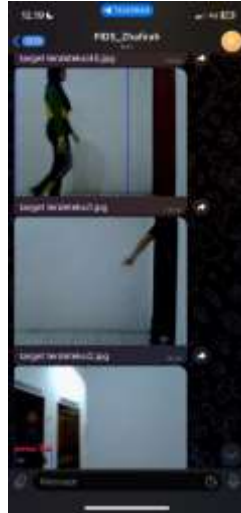
**Figure 9.** Tool Circuit Schematic

Based on Figure 9. above, there are 2 central processing controllers, namely Esp32 and Raspberry Pi 4. On Esp32 there is a Buzzer output, there are 2 pins used, namely the signal pin and Gnd. The physical form that has been designed can be seen in the image below



**Figure 10.** Physical Form of the Tool

Based on the image above, the working system of the tool is: monitoring the area with a USB Webcam surveillance camera and sending notifications to telegram and can see the live streaming via WEB, if a human is detected in the area, the alarm from the buzzer sounds and sends a message of the captured image to telegram. Artificial Intelligence (AI) is used to detect movement and the Esp32 Microcontroller becomes the control center with buzzer output. The results of the image display on the telegram are as follows.



**Figure 11.** Telegram Bot View

This overall design utilizes a +5 Volt voltage source to activate the Raspberry Pi 4 which is connected to the USB Webcam and ESP 32. Then from the ESP 32 it is connected to the buzzer. This system will work if all components receive power with the appropriate voltage, such as the ESP 32 which requires a voltage of 3.3V to activate the buzzer connected to it. In addition, this design also requires an internet connection via a hotspot in order to operate. How this design works starts with a webcam that detects an object, then the object is analyzed by Artificial Intelligence programmed into the Raspberry Pi module to determine whether the object is human or not. If the object detected is human, the AI will instruct the buzzer to sound and send a notification to Telegram, and can be seen on live streaming on the web. However, if the object detected is not human, the buzzer will not sound.

## CONCLUSION

Based on the results of the research and testing of the tools carried out, the researcher obtained the following conclusions: *Perimeter Intrusion Detection System*(PIDS) based on telegram and web notifications consists of the main components, namely, a USB Webcam as a surveillance camera integrated by Artificial Intelligence (AI) to detect human movement, then there is ESP 32 as a control center with a buzzer output when humans are detected. This system runs when the Raspberry PI 4 is connected to the internet and can send notifications to Telegram in the form of documentation of portraits from a USB Webcam. This system can do live streaming using the local host that has been provided. The results of photos and videos that have been captured by the camera can be viewed on the Raspberry Pi 4 storage.

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