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Intrusion Detection System Design Using Webcam And Artificial Intelligence In Aviation Polytechnic Medan

Dinda Suci Aliya Permata[1]* , Liber Tommy Hutabarat[2], Darmeli Nasution[3]

[1,2,3] Aviation Polytechnic Medan

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Abstract

Security systems are needed to maintain the safety and comfort of an area as well as on the Medan Aviation Polytechnic campus which requires a security system to protect the campus area. In an effort to maintain security and assist surveillance in the Medan Aviation Polytechnic campus area, an intrusion detection system is designed to monitor areas that are rarely reached by security officers to monitor any suspicious activity. The purpose of this design is to detect unauthorized activities so that it can assist security officers in maintaining security in the Medan Aviation Polytechnic campus environment. Artificial intelligence in this system helps to determine the target detected by the webcam, so that the buzzer will sound if the target detected is human. The results of this study indicate that this system is able to detect humans and Artificial Intelligence can detect humans so that the buzzer sounds when a human is detected.

Keywords: Intrusion Detection System, Webcam, Artificial Intelligence, Campus Security, Detection

(*) Corresponding Author: aliyapermatadindasuci@gmail.com

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INTRODUCTION

Security system is a system that is useful for maintaining security and as a way of preventing the occurrence of a danger or crime. Security systems are used to protect assets, information, and individuals from threats and dangers. Examples of security that usually require security systems such as physical security, network security, data security, environmental security, and perimeter security. Perimeter security is one aspect of a security system that focuses on protecting physical areas from external threats through access control and surveillance around property or facility boundaries. The goal is to prevent and detect unauthorized access, threats, or suspicious activity before it reaches critical points within the protected area.

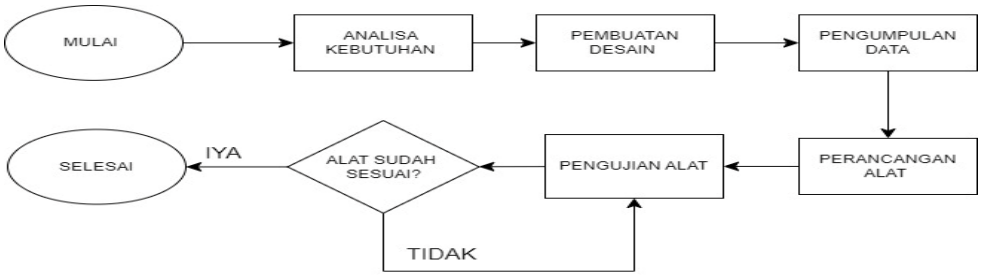
Based on events that have occurred, where there are cadets who escape through fences that are rarely reached by security officers. So the need for a security system that can monitor areas that are rarely reached by security officers in the Medan Aviation Polytechnic campus environment, by designing an intrusion detection system that is expected to be able to increase security by monitoring the fence to detect suspicious activity or unauthorized access.

This design uses a Webcam as a tool to record images. However, in general, webcams cannot distinguish between humans and other objects. So additional technology is needed to distinguish between humans and other objects as targets to be detected. By adding artificial intelligence or commonly known as

Artificial Intelligence (AI) can increase detection accuracy, to be able to distinguish between humans and animals. This system also uses a buzzer as an alarm that only sounds when a human is detected by the camera. If the object detected is not human then the buzzer will not sound.

RESEARCH METHOD

The research and development method is a research method used to produce certain products and test their effectiveness (Fransisca & Putri, 2019). This research method is in accordance with the research design carried out which produces a product in the form of a detection system design and tests the design that has been designed. The following is the flow of the research design:



Figur 1. Research Design

RESULTS AND DISCUSSION

Hardware Design

Object detection design

The design for detecting objects consists of a webcam and raspberry. Webcam serves to capture image captures and raspberries are useful for processing the results of image captures. On the raspberry, an AI program has been created which is used to detect humans. How to make an object detection design is by connecting the USB cable on the webcam to the USB port on the raspberry pi 4.

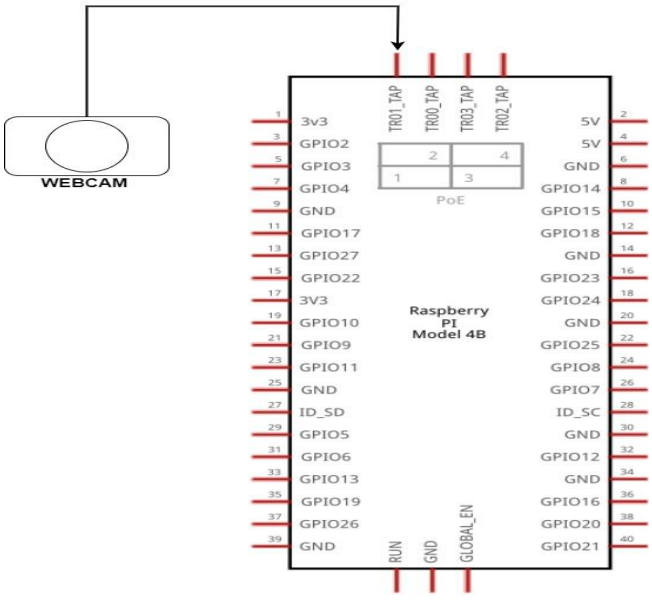


Figure 2. Wiring from raspberry pi 4 with webcam

Buzzer alarm design

ESP 32 is used to activate the buzzer. The buzzer is useful as an alarm when a human is detected by AI. The way to make a buzzer alarm design is to connect the buzzer foot to the GND pin and pin 23 on the ESP 32. If the buzzer is connected to the ESP 32, an internet connection is needed to be able to activate the buzzer, because the ESP 32 is based on IoT (Internet of Things) which requires an internet connection to run its commands.

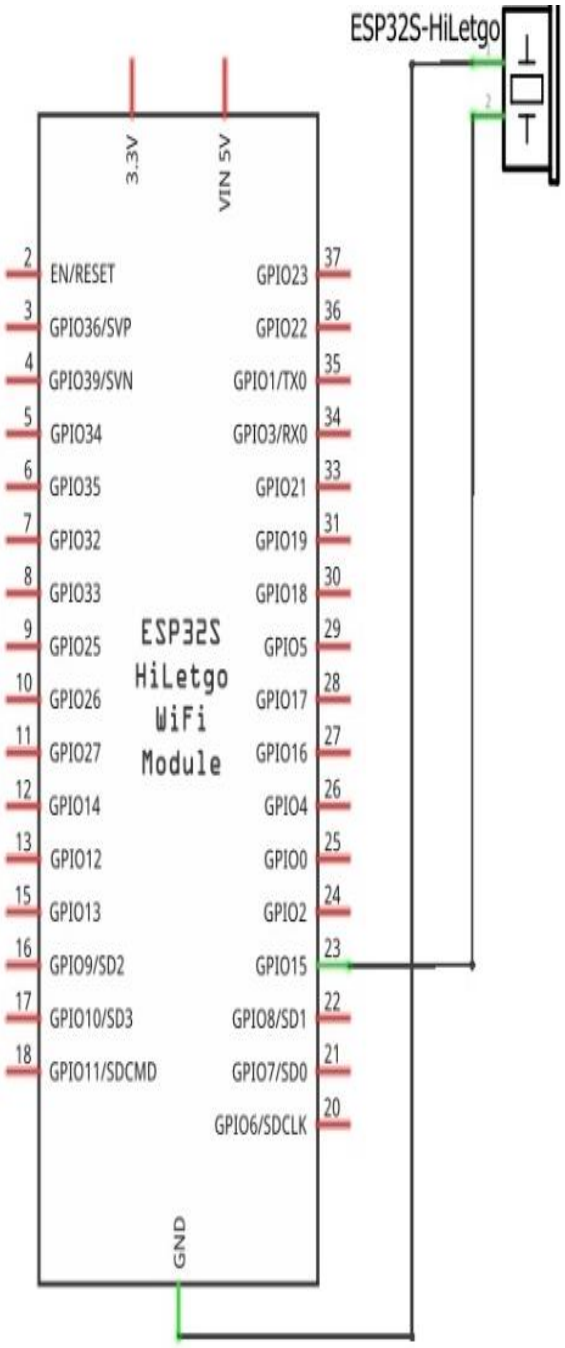


Figure 3. Wiring ESP 32 with buzzer

Adapter

In order for the design to be active and work, a power supply is needed. Power supply is a voltage source that comes from a power supply. This design uses an adapter as a voltage source for all design components. The adapter works by changing the AC voltage of 220 Volts to a DC voltage of 5 Volts.

Overall design

The overall design is a combination of all designs that have been made. The following are the results of the Intrusion Detection System Design Using Webcam and Artificial Intelligence at Medan Aviation Polytechnic:

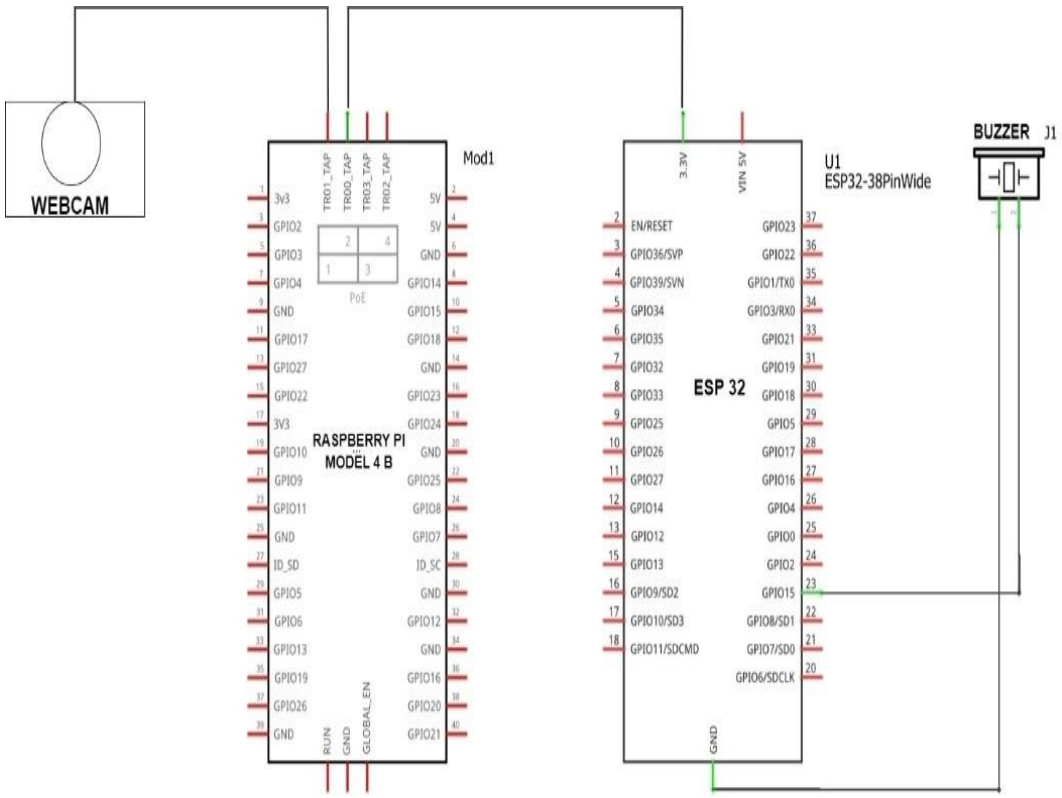


Figure 4. Wiring the overall design

This design uses a voltage source of +5 Volts. This voltage is used to activate the Raspberry Pi 4, ESP 32 which is connected to the buzzer and webcam. The design can be active if all system components have received power with the appropriate voltage such as ESP 32 which requires a voltage of 3.3V to work to activate the buzzer connected to ESP 32. Then the design requires an internet hotspot for the design to work. The way this design works starts from a webcam that detects objects then the object is processed by Artificial Intelligence programmed on the raspberry module whether the object is human or not. If the target captured is a human then AI will order the buzzer to sound. Conversely, if the object detected is not human, the buzzer does not sound.

Software Design

Object Detection Design

In designing object detection in software, it is necessary to install Python downloaded via https://www.python.org/downloads/ which is the official python website. Using the official website ensures security and reduces the risk of the application being modified by irresponsible parties. To use python, it is necessary to open the Command Prompt as a medium to activate the python program. After python is installed, then open the Command Prompt to run the program. Command Prompt is used as a terminal to activate the system as a system configuration for windows.How to install the Opencv library, namely by opening a command prompt or terminal window then running the following command:

```
pip install opencv-python
```

To get the library from OpenCV, you can download it on the website https://pypi.org/project/opencv-python/ and numpy on the website https://pypi.org/project/numpy/ to get the programming library. Here's how to program OpenCV to detect humans:

Import the required libraries

The purpose of importing the necessary libraries is to create a program according to the command you want to run. The following libraries are needed to create a program:

```
import cv2
import numpy as np
import json
import threading
```

Import cv2 is a library from Opencv for general object image processing. The numpy import is used for numerical data manipulation and analysis. The json import is used to help python read the data in the program created. And threading imports are used to help improve application responsiveness.

Connecting the webcam with the program

Connecting the webcam used with the designed program aims to make the webcam readable by the program. So that the AI program can process the captured images from the webcam. The following is the code to connect the camera:

```
#Camera initialization
camera = cv2.VideoCapture(0)
cap = cv2.VideoCapture(ip_camera_url)
```

The format of (ip_camera_url) aims to input the ip address of the camera connected to the program. So that the AI program can process the results of image capture from the ip camera inputted into the program.

Human reading

Create a command code for the program to read the target in the form of a human. The following is the code to detect humans:

```
classes = json.load(open("dataset.json"))
net = cv2.dnn.readNetFromONNX("yolov5s.onnx")

if label == “person”:
   line = “rec”
```

The command code from dataset.json contains data that will be detected by AI, one of the data in dataset.json is humans so that AI can detect

humans. While the command code from yolov5s.onnx is a command to detect objects in real time.

Creating a camera capture view

In the camera capture display there is a frame that is used to help provide information on objects detected by the webcam. The following is the code to create the frame:

```
img_width, img_height = frame.shape[1], frame.shape[0]
    x_scale = img_width / 320
    y_scale = img_height / 320
    box = np.array([x1, y1, width, height])
    boxes.append(box)
```

Running the program

After all the coding has been designed, the coding needs to be run to see the results of the program that has been created. Running the program is needed to find out whether the program designed is in accordance with the desired command. The way to run the program is by pressing the 'Run' menu in VS Code as shown in Figure 5 below:

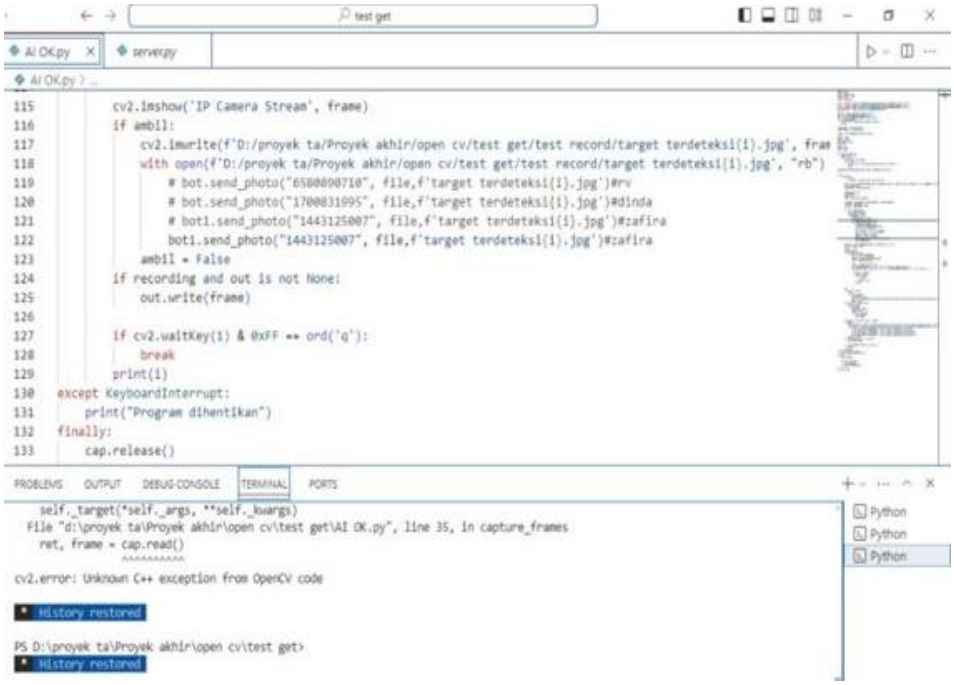


Figure 5. Program Display

The results of running the programming that has been done, the webcam can detect humans assisted by AI as shown in Figure 6 below:

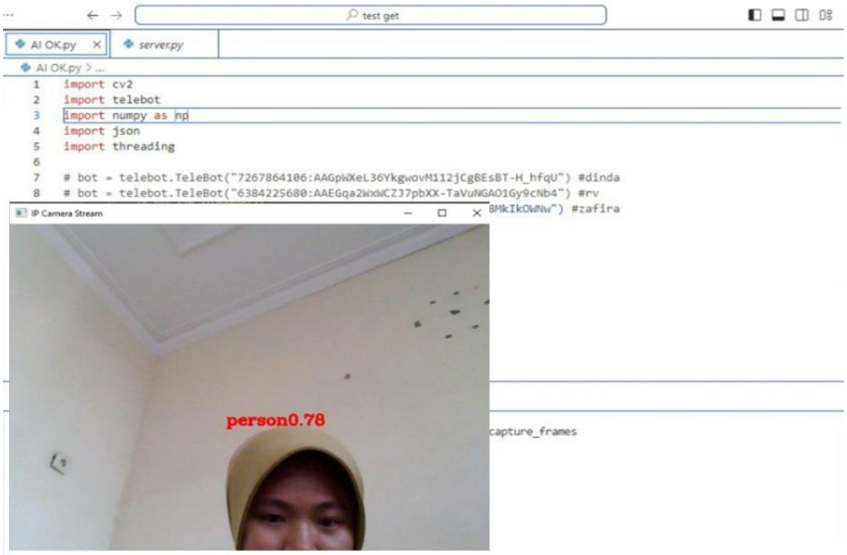


Figure 6. Program results after running

The captured image from the webcam has an indicator 'person0.78' which is a description of the detected object. The number on the indicator is the accuracy of the object detected by AI. The number indicator can change according to the detected object.

Testing the Design against Objects

Design testing on objects is carried out to find out whether AI can detect humans recorded by a webcam and to find out whether the buzzer sounds when humans are detected. This test also tests the object detected, the effect of distance on the design, the delay time required by the buzzer and the effectiveness of light on the design. The results of the tests that have been carried out can be seen in Table 1 as follows:

Table 1. Design testing results

No.	Taste Object	Distance	Buzzer sounds	Time delay buzzer responds to object	Testing		
					Daytime	Nighttime (Insufficient light)	Nighttime (sufficient light)
1.	Broom	2 m	No	No buzzer sounds because the object is not human	Good image capture condition	Poor image capture conditions	Good image capture condition
		4 m	No				
		6 m	No				
		8 m	No				
2.	Shoes	2 m	No	No buzzer sounds because the object	Good image capture condition	Poor image capture conditions	Good image capture condition
		4 m	No				
		6 m	No				

		8 m	No	is not human			
3.	Cat	2 m	No	No buzzer sounds because the object is not human	Good image capture condition	Poor image capture conditions	Good image capture condition
		4 m	No				
		6 m	No				
		8 m	No				
4.	Human Walking	2 m	Yes	2 sec	Good image capture condition	Poor image capture conditions	Good image capture condition
		4 m	Yes	2 sec			
		6 m	Yes	3 sec			
		8 m	Yes	4 sec			
5.	Man standing still	2 m	Yes	2 sec	Good image capture condition	Poor image capture conditions	Good image capture condition
		4 m	Yes	2 sec			
		6 m	Yes	2 sec			
		8 m	Yes	3 sec			

Based on the testing that has been done, it is known that the design can detect humans and the buzzer sounds when humans are detected. And when objects other than humans are detected the buzzer does not sound. This intrusion detection system design has a delay time due to the AI program that takes time to process objects recorded by the webcam. The delay time is influenced by the distance of the detected object. The farther the distance of the detected object, the longer the delay time required. This design requires sufficient lighting so that the design can work more optimally.

CONCLUSION

After testing the design of the intrusion detection system using a webcam and AI, the following conclusions can be drawn:

1. The design of an intrusion detection system using a webcam and AI can operate when connected to an internet network.
2. This intrusion detection system design can detect objects that cross the webcam, these objects can be humans. AI can distinguish objects that cross the webcam, so that when the recorded object is a human, the buzzer is active and sounds. But when the recorded object is not human, the buzzer is not active and does not sound.
3. The farther the distance of the detected object, the longer the response from the buzzer because there is a delay time which is the process of AI to translate the detected object. The buzzer will continue to sound as long as there are humans recorded by the webcam.
4. This intrusion detection system design requires sufficient lighting for the design to work optimally.

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