Project Documentation: Arming Against Violence - YOLO-Based Weapon Detection

1. Introduction

1.1 Project Overview

The Arming Against Violence project aims to enhance public safety and security by implementing a YOLO (You Only Look Once) based weapon detection system. The system is designed to identify and alert security personnel when weapons are detected in real-time using computer vision.

1.2 Purpose

Implement a YOLO-based object detection system to identify weapons in images or video streams.
Develop an alert mechanism to notify security personnel when a weapon is detected.
Enhance the system's accuracy, speed, and robustness to various environmental conditions.

2. LITERATURE SURVEY

2.1 Existing problem

The existing problem revolves around the increasing need for advanced security measures to counteract potential acts of violence, particularly those involving firearms and other weapons. Traditional security systems often fall short in efficiently detecting and responding to such threats in real-time. In crowded public spaces, critical infrastructure, or events, there is a growing demand for intelligent systems capable of quickly identifying and alerting security personnel to the presence of weapons.

2.2 References

2.2.1
https://www.analyticsvidhya.com/blog/2022/06/yolo-algorithm-for-custom-object-detection

2.2.2
https://youtu.be/WgPbbWmnXJ8?si=KJZkHmQFgBJxhocz

2.3 Problem Statement Definition

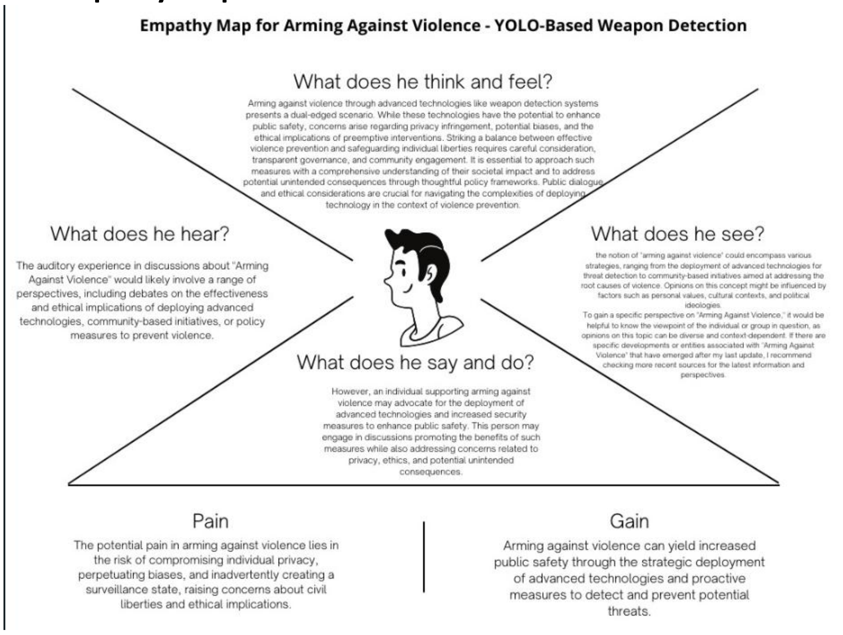
The problem addressed by the "Arming Against Violence" project is the need for an intelligent and efficient weapon detection system. The specific challenges to be tackled include:

Real-Time Weapon Detection: Develop a YOLO-based system capable of accurately detecting weapons in real-time from images or video streams.
Alert Mechanism: Implement an effective alert mechanism that promptly notifies security personnel upon the detection of a weapon, ensuring a swift response.
Integration: Ensure seamless integration with existing security infrastructure, allowing for a comprehensive and cohesive security system.
Privacy Considerations: Develop mechanisms to balance the need for security with individual privacy rights, addressing concerns associated with surveillance.
Scalability: Design the system to be scalable, capable of covering large areas and adapting to diverse environmental conditions.

By addressing these challenges, the project aims to contribute to the development of a proactive and intelligent security system that enhances public safety and security measures in various contexts.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



Empathy Map for Arming Against Violence - YOLO-Based Weapon Detection

What does he think and feel?

Arming against violence through advanced technologies like weapon detection systems presents a dual-edged scenario. While these technologies have the potential to enhance public safety, concerns arise regarding privacy infringement, potential biases, and the ethical implications of preemptive interventions. Striking a balance between effective violence prevention and safeguarding individual liberties requires careful consideration, transparent governance, and community engagement. It is essential to approach such measures with a comprehensive understanding of their societal impact and to address potential unintended consequences through thoughtful policy frameworks. Public dialogue and ethical considerations are crucial for navigating the complexities of deploying technology in the context of violence prevention.

What does he hear?

The auditory experience in discussions about "Arming Against Violence" would likely involve a range of perspectives, including debates on the effectiveness and ethical implications of deploying advanced technologies, community-based initiatives, or policy measures to prevent violence.

What does he see?

the notion of "arming against violence" could encompass various strategies, ranging from the deployment of advanced technologies for threat detection to community-based initiatives aimed at addressing the root causes of violence. Opinions on this concept might be influenced by factors such as personal values, cultural contexts, and political ideologies.
To gain a specific perspective on "Arming Against Violence," it would be helpful to know the viewpoint of the individual or group in question, as opinions on this topic can be diverse and context-dependent. If there are specific developments or entities associated with "Arming Against Violence" that have emerged after my last update, I recommend checking more recent sources for the latest information and perspectives.

What does he say and do?

However, an individual supporting arming against violence may advocate for the deployment of advanced technologies and increased security measures to enhance public safety. This person may engage in discussions promoting the benefits of such measures while also addressing concerns related to privacy, ethics, and potential unintended consequences.

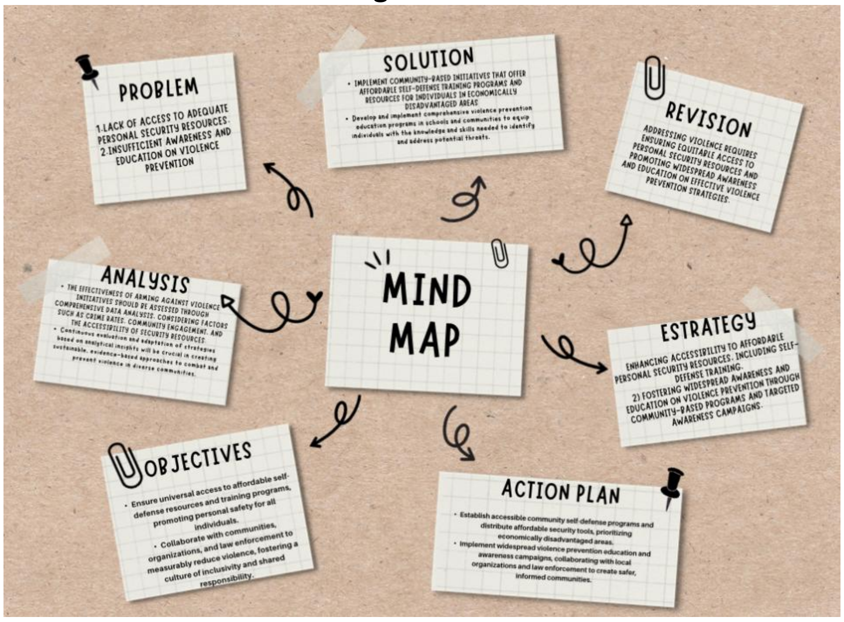
Pain

The potential pain in arming against violence lies in the risk of compromising individual privacy, perpetuating biases, and inadvertently creating a surveillance state, raising concerns about civil liberties and ethical implications.

Gain

Arming against violence can yield increased public safety through the strategic deployment of advanced technologies and proactive measures to detect and prevent potential threats.

3.2 Ideation & Brainstorming



MIND MAP

PROBLEM

1.LACK OF ACCESS TO ADEQUATE PERSONAL SECURITY RESOURCES.
2.INSUFFICIENT AWARENESS AND EDUCATION ON VIOLENCE PREVENTION

SOLUTION

- IMPLEMENT COMMUNITY-BASED INITIATIVES THAT OFFER AFFORDABLE SELF-DEFENSE TRAINING PROGRAMS AND RESOURCES FOR INDIVIDUALS IN ECONOMICALLY DISADVANTAGED AREAS
- Develop and implement comprehensive violence prevention education programs in schools and communities to equip individuals with the knowledge and skills needed to identify and address potential threats.

REVISION

ADDRESSING VIOLENCE REQUIRES ENSURING EQUITABLE ACCESS TO PERSONAL SECURITY RESOURCES AND PROMOTING WIDESPREAD AWARENESS AND EDUCATION ON EFFECTIVE VIOLENCE PREVENTION STRATEGIES.

ANALYSIS

- THE EFFECTIVENESS OF ARMING AGAINST VIOLENCE INITIATIVES SHOULD BE ASSESSED THROUGH COMPREHENSIVE DATA ANALYSIS. CONSIDERING FACTORS SUCH AS CRIME RATES. COMMUNITY ENGAGEMENT. AND THE ACCESSIBILITY OF SECURITY RESOURCES.
- Continuous evaluation and adaptation of strategies based on analytical insights will be crucial in creating sustainable. evidence-based approaches to combat and prevent violence in diverse communities.

ESTRATEGY

ENHANCING ACCESSIBILITY TO AFFORDABLE PERSONAL SECURITY RESOURCES. INCLUDING SELF-DEFENSE TRAINING.
2) FOSTERING WIDESPREAD AWARENESS AND EDUCATION ON VIOLENCE PREVENTION THROUGH COMMUNITY-BASED PROGRAMS AND TARGETED AWARENESS CAMPAIGNS.

OBJECTIVES

- Ensure universal access to affordable self-defense resources and training programs, promoting personal safety for all individuals.
- Collaborate with communities, organizations, and law enforcement to measurably reduce violence, fostering a culture of inclusivity and shared responsibility.

ACTION PLAN

- Establish accessible community self-defense programs and distribute affordable security tools, prioritizing economically disadvantaged areas.
- Implement widespread violence prevention education and awareness campaigns, collaborating with local organizations and law enforcement to create safer, informed communities.

4. Requirement Analysis

4.1 Functional Requirements

4.1.1 Object Detection

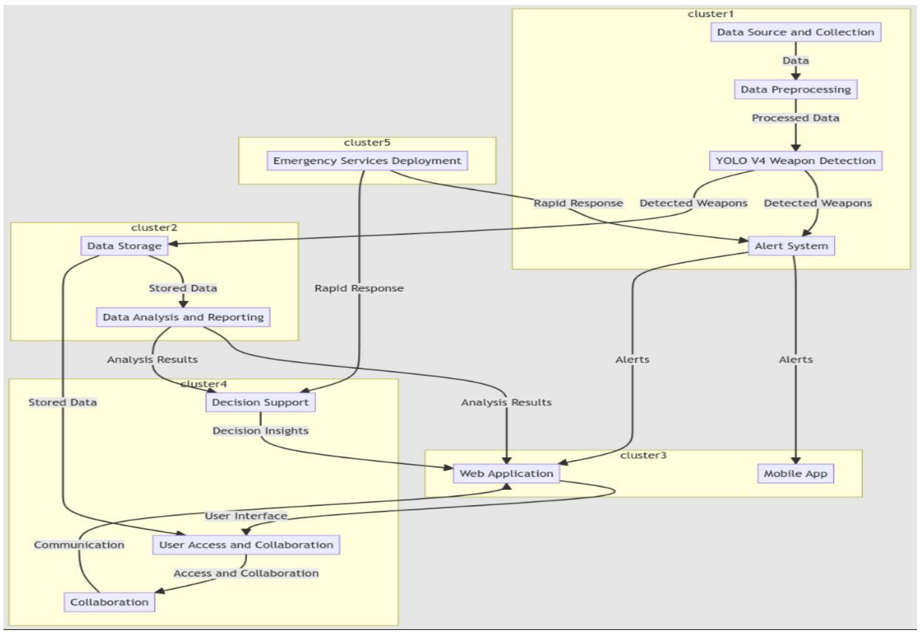
Real-Time Detection:

The system must perform real-time object detection using the YOLO algorithm.
It should efficiently process images or video frames to identify objects, with a focus on accurately detecting weapons.

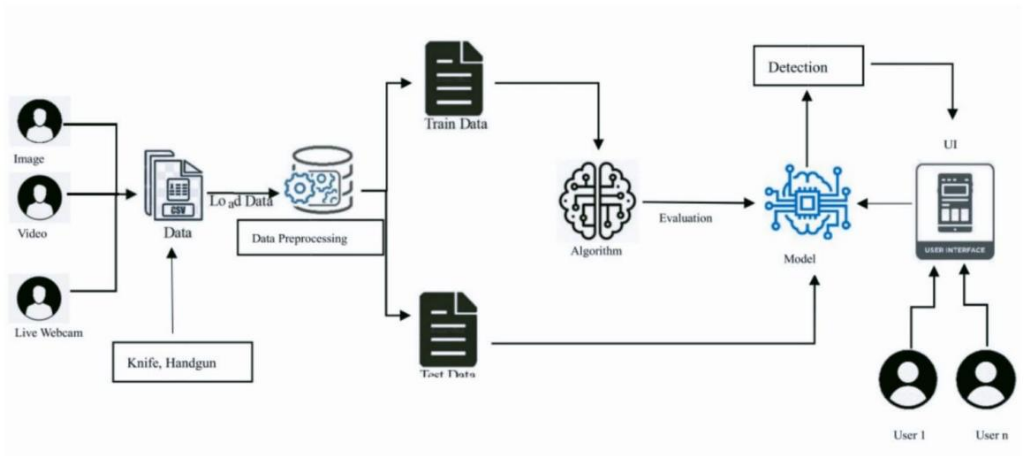
Multiple Object Recognition:
The system should be capable of recognizing and classifying multiple objects simultaneously.
Object categories may include weapons, people, and other relevant entities.
Alert Triggering:
Upon detecting a weapon, the system must trigger an alert mechanism.
The alert should be immediate and capable of notifying security personnel through various channels.
4.1.2 Alert Mechanism
Visual Alerts:
Implement a visual alert system to notify security personnel of the detected threat.
The alert should include relevant information about the detected object, such as its location.
Audio Alerts:
Provide an audible alert, such as a siren or notification sound, to attract attention in the vicinity.
Ensure that audio alerts are distinguishable and not disruptive to the surrounding environment.
4.2 Non-Functional Requirements
4.2.1 Performance
Accuracy:
Achieve a high level of accuracy in weapon detection to minimize false positives and negatives.
Regularly update and fine-tune the detection model to improve accuracy.
Speed:
Ensure real-time processing and detection to enable swift responses to potential threats.
Optimize algorithms and system components for efficiency.
4.2.5 User Interface
Intuitive Web Interface:
If applicable, provide a user-friendly web interface for system configuration and monitoring.
Ensure ease of use for security personnel and administrators.
Real-Time Display:
If applicable, display real-time object detection results on the user interface.
Include features for historical data analysis and reporting.
These requirements serve as a foundation for the development and deployment of the "Arming Against Violence" system, ensuring that it meets functional needs, performs reliably, and adheres to security and privacy standards.

5. PROJECT DESIGN

5.1 Data Flow Diagrams

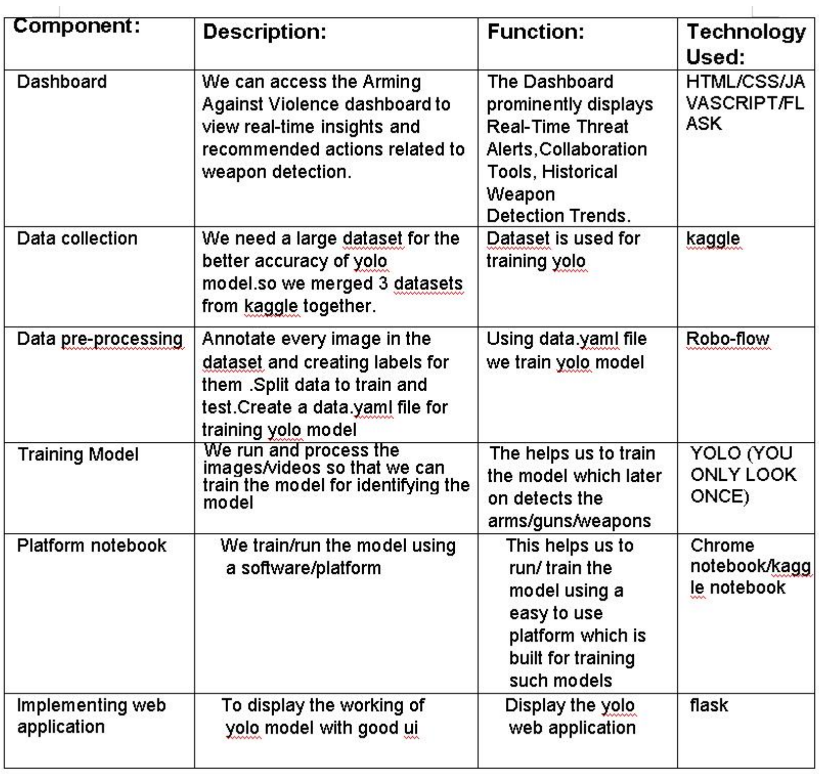


5.2 Solution Architecture



6. PROJECT PLANNING & SCHEDULING

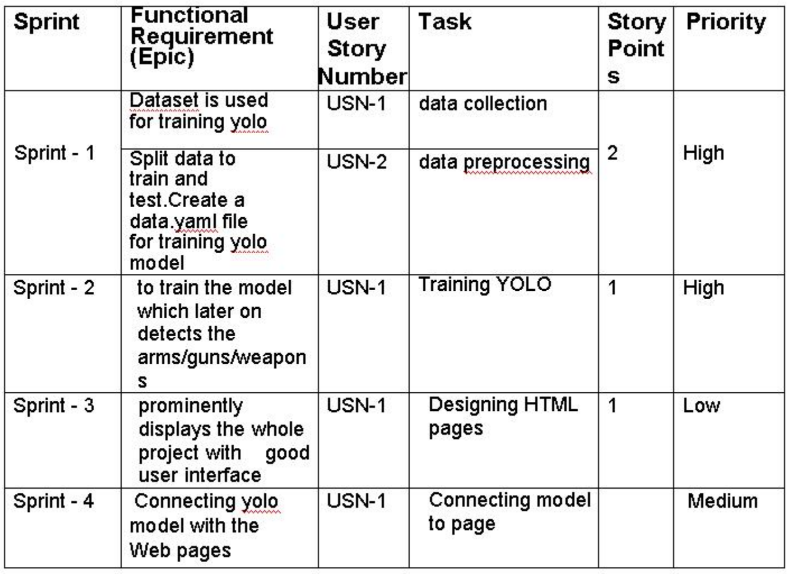
6.1 Technical Architecture



Component:	Description:	Function:	Technology Used:
Dashboard	We can access the Arming Against Violence dashboard to view real-time insights and recommended actions related to weapon detection.	The Dashboard prominently displays Real-Time Threat Alerts,Collaboration Tools, Historical Weapon Detection Trends.	HTML/CSS/JAVASCRIPT/FLASK
Data collection	We need a large dataset for the better accuracy of yolo model.so we merged 3 datasets from kaggle together.	Dataset is used for training yolo	kaggle
Data pre-processing	Annotate every image in the dataset and creating labels for them .Split data to train and test.Create a data.yaml file for training yolo model	Using data.yaml file we train yolo model	Robo-flow
Training Model	We run and process the images/videos so that we can train the model for identifying the model	The helps us to train the model which later on detects the arms/guns/weapons	YOLO (YOU ONLY LOOK ONCE)
Platform notebook	We train/run the model using a software/platform	This helps us to run/ train the model using a easy to use platform which is built for training such models	Chrome notebook/kaggle notebook
Implementing web application	To display the working of yolo model with good ui	Display the yolo web application	flask

6.2 Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation:



Sprint	Functional Requirement (Epic)	User Story Number	Task	Story Points	Priority
Sprint - 1	Dataset is used for training yolo	USN-1	data collection	2	High
	Split data to train and test.Create a data.yaml file for training yolo model	USN-2	data preprocessing		
Sprint - 2	to train the model which later on detects the arms/guns/weapons	USN-1	Training YOLO	1	High
Sprint - 3	prominently displays the whole project with good user interface	USN-1	Designing HTML pages	1	Low
Sprint - 4	Connecting yolo model with the Web pages	USN-1	Connecting model to page		Medium

6.3 Sprint Delivery Schedule

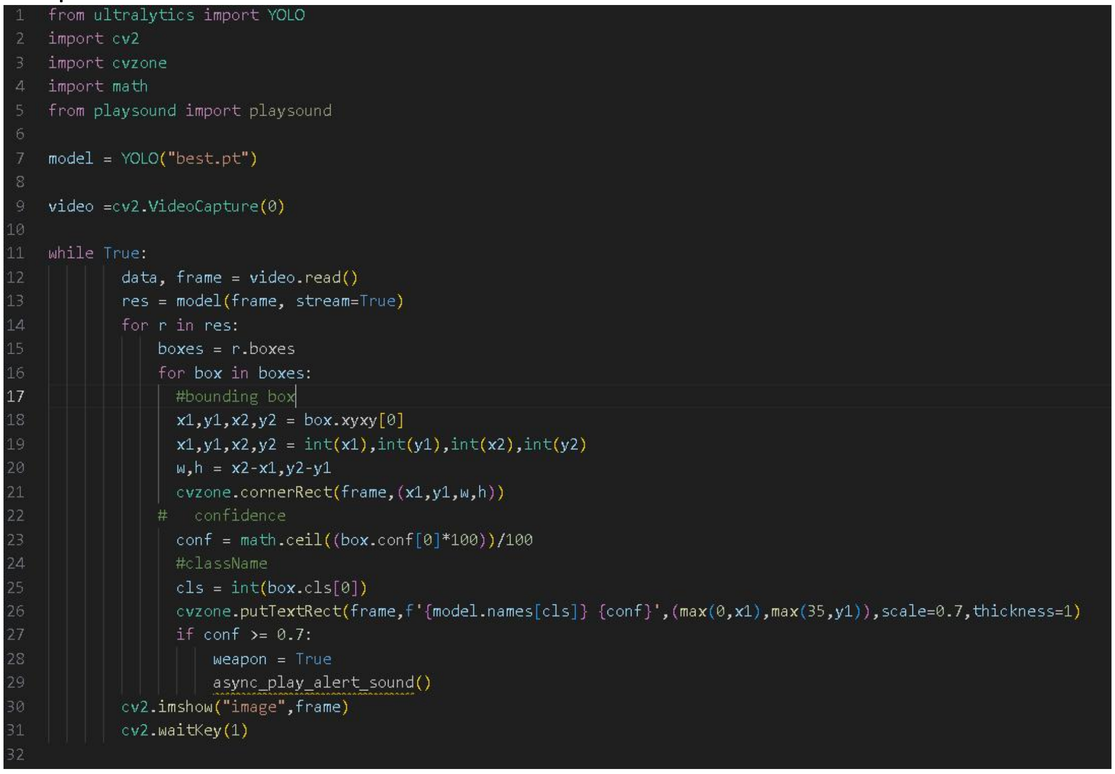
Product Backlog, Sprint Schedule, and Estimation:

Sprint no:	Task:	Sprint Start Date:	Sprint End Date:	Duration:
sprint 1	Data collection, Data pre-processing	Nov 1	Nov 4	3 Days
sprint 2	Training	Nov 5	Nov 8	3 Days
sprint 3	Designing HTML pages	Nov 9	Nov 14	5 Days
sprint 4	connecting model to page	Nov 15	Nov 18	3 Days

7. CODING & SOLUTIONING

7.1 Feature 1: Real-Time Object Detection with YOLO

This feature involves implementing real-time object detection using the YOLO algorithm. The system should be able to process images or video frames, identify objects, and display bounding boxes around the detected objects, with a focus on weapons.

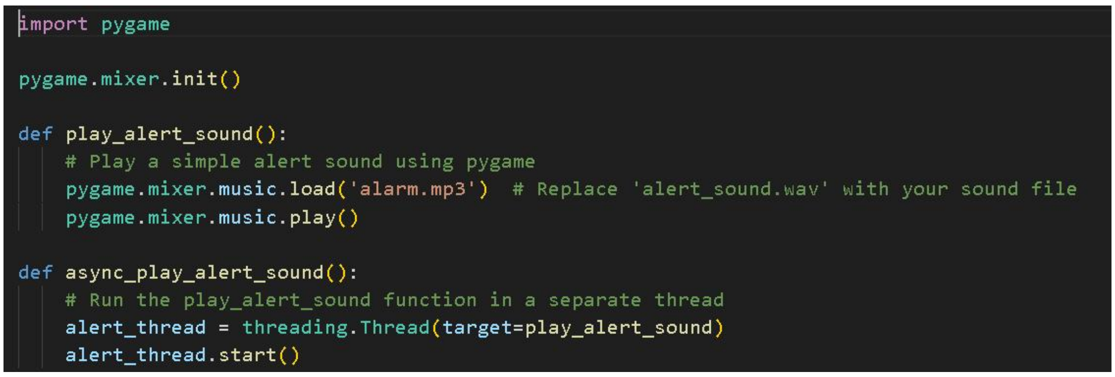


```
from ultralytics import YOLO
import cv2
import cvzone
import math
from playsound import playsound

model = YOLO("best.pt")

video =cv2.VideoCapture(0)

while True:
        data, frame = video.read()
        res = model(frame, stream=True)
        for r in res:
            boxes = r.boxes
            for box in boxes:
              #bounding box
              x1,y1,x2,y2 = box.xyxy[0]
              x1,y1,x2,y2 = int(x1),int(y1),int(x2),int(y2)
              w,h = x2-x1,y2-y1
              cvzone.cornerRect(frame,(x1,y1,w,h))
            #   confidence
              conf = math.ceil((box.conf[0]*100))/100
              #className
              cls = int(box.cls[0])
              cvzone.putTextRect(frame,f'{model.names[cls]} {conf}',(max(0,x1),max(35,y1)),scale=0.7,thickness=1)
              if conf >= 0.7:
                  weapon = True
                  async_play_alert_sound()
        cv2.imshow("image",frame)
        cv2.waitKey(1)

```

This code uses the YOLO model to detect objects in an image, draws bounding boxes around the detected objects, and displays the results.

7.2 Feature 2: Alert Mechanism with Pygame

This feature involves implementing an alert mechanism that triggers visual and audio alerts when a weapon is detected. In this example, Pygame is used to play an alert sound.



```
import pygame

pygame.mixer.init()

def play_alert_sound():
    # Play a simple alert sound using pygame
    pygame.mixer.music.load('alarm.mp3')  # Replace 'alert_sound.wav' with your sound file
    pygame.mixer.music.play()

def async_play_alert_sound():
    # Run the play_alert_sound function in a separate thread
    alert_thread = threading.Thread(target=play_alert_sound)
    alert_thread.start()
```

This code initializes Pygame, loads an alert sound file, plays the sound, and stops it after a specified duration. You can integrate this function into your system to trigger alerts when weapons are detected.

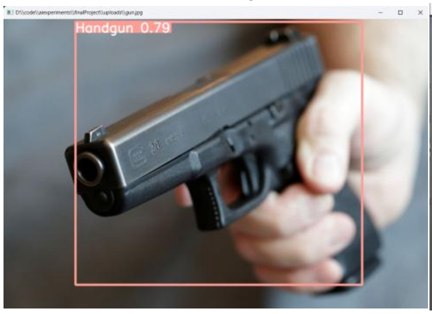
These features provide the foundation for real-time object detection and an alert mechanism in the "Arming Against Violence" project. Depending on your specific requirements, you may need to integrate these features into a larger system, handle multiple cameras, and address security considerations.

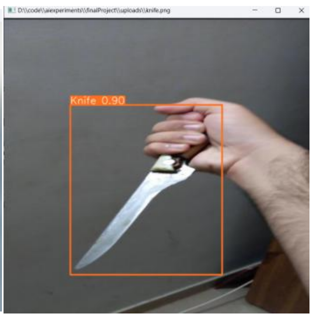
8. Performance Testing

Performance testing is crucial to ensure that the "Arming Against Violence" system meets the desired standards in terms of accuracy, speed, reliability, and scalability. The following performance metrics are essential for evaluating the effectiveness of the system:

8.1 Accuracy Metrics:

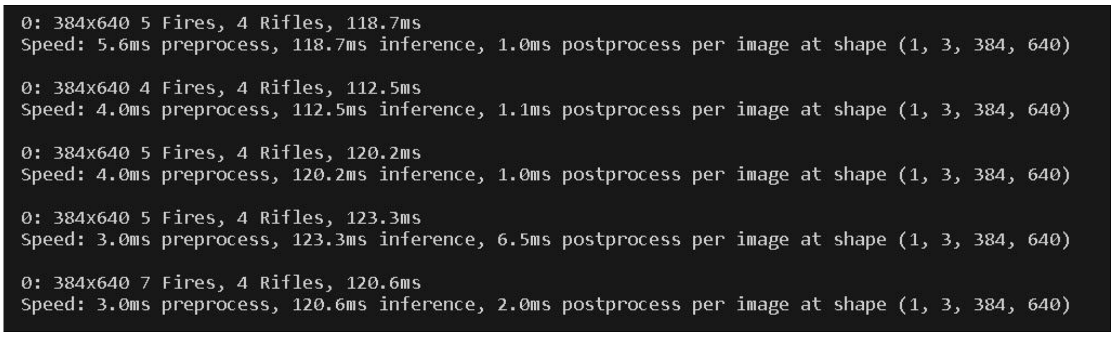
Detection Accuracy:





8.2 Speed Metrics:

Frame Processing Time:

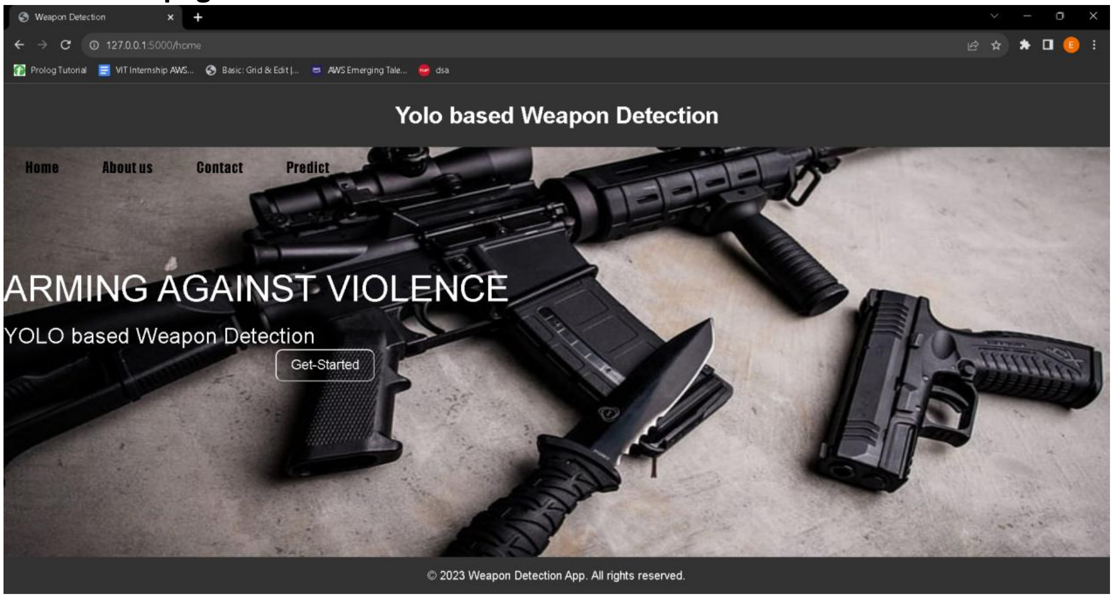


```
0: 384x640 5 Fires, 4 Rifles, 118.7ms
Speed: 5.6ms preprocess, 118.7ms inference, 1.0ms postprocess per image at shape (1, 3, 384, 640)

0: 384x640 4 Fires, 4 Rifles, 112.5ms
Speed: 4.0ms preprocess, 112.5ms inference, 1.1ms postprocess per image at shape (1, 3, 384, 640)

0: 384x640 5 Fires, 4 Rifles, 120.2ms
Speed: 4.0ms preprocess, 120.2ms inference, 1.0ms postprocess per image at shape (1, 3, 384, 640)

0: 384x640 5 Fires, 4 Rifles, 123.3ms
Speed: 3.0ms preprocess, 123.3ms inference, 6.5ms postprocess per image at shape (1, 3, 384, 640)

0: 384x640 7 Fires, 4 Rifles, 120.6ms
Speed: 3.0ms preprocess, 120.6ms inference, 2.0ms postprocess per image at shape (1, 3, 384, 640)
```

9. RESULTS

9.1 Output

9.1.1 Home page


Weapon Detection
127.0.0.1:5000/home
Yolo based Weapon Detection
Home
About us
Contact
Predict
ARMING AGAINST VIOLENCE
YOLO based Weapon Detection
Get-Started
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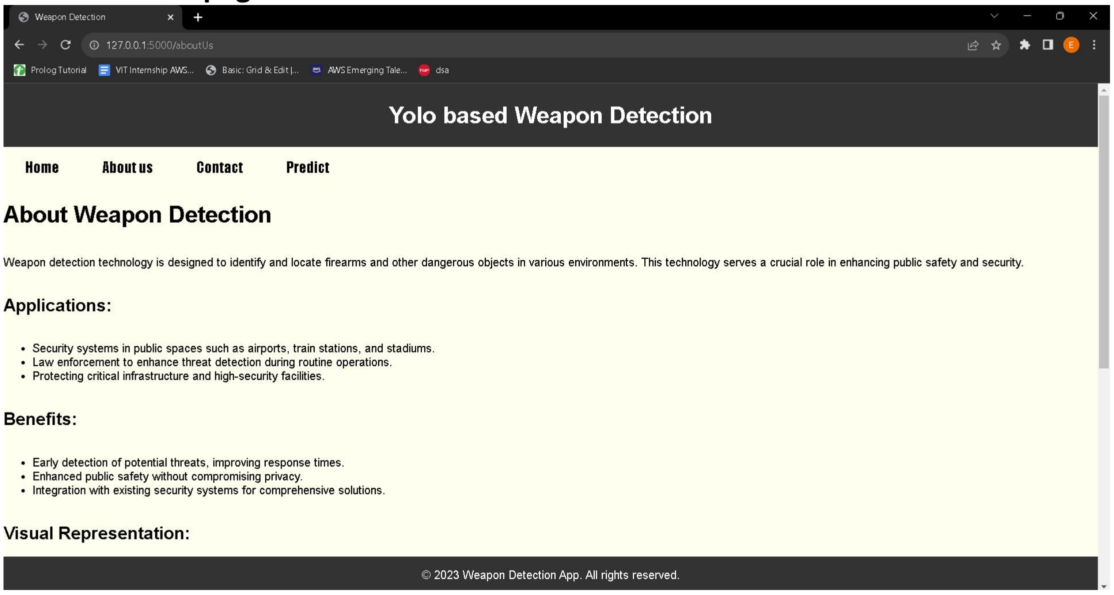
9.1.2 About us page



About Weapon Detection

Weapon detection technology is designed to identify and locate firearms and other dangerous objects in various environments. This technology serves a crucial role in enhancing public safety and security.

Applications:

- Security systems in public spaces such as airports, train stations, and stadiums.
- Law enforcement to enhance threat detection during routine operations.
- Protecting critical infrastructure and high-security facilities.

Benefits:

- Early detection of potential threats, improving response times.
- Enhanced public safety without compromising privacy.
- Integration with existing security systems for comprehensive solutions.

Visual Representation:

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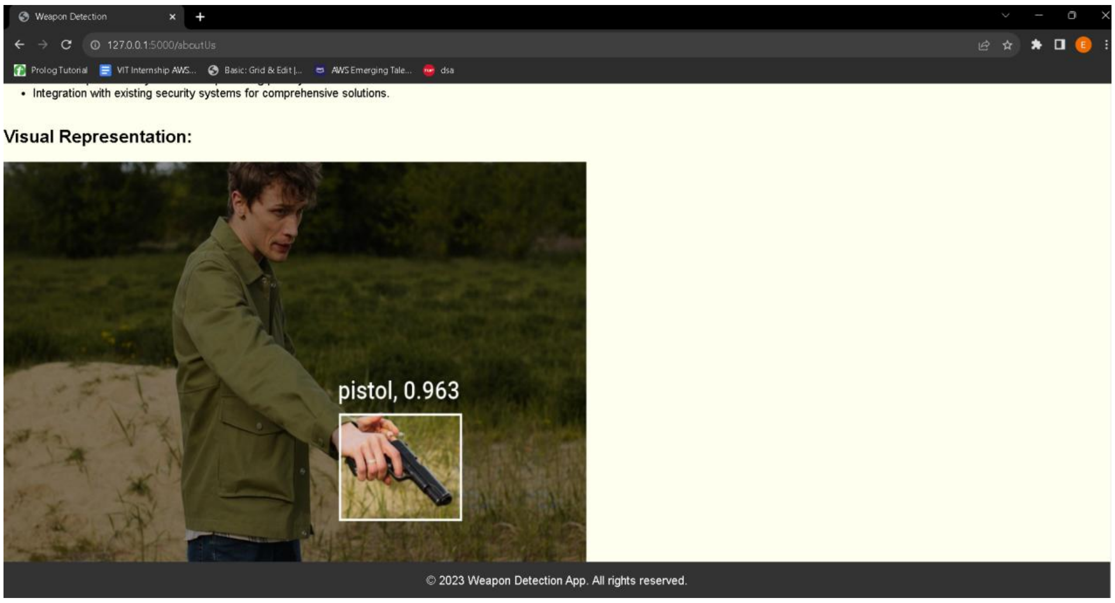

- Integration with existing security systems for comprehensive solutions.

Visual Representation:

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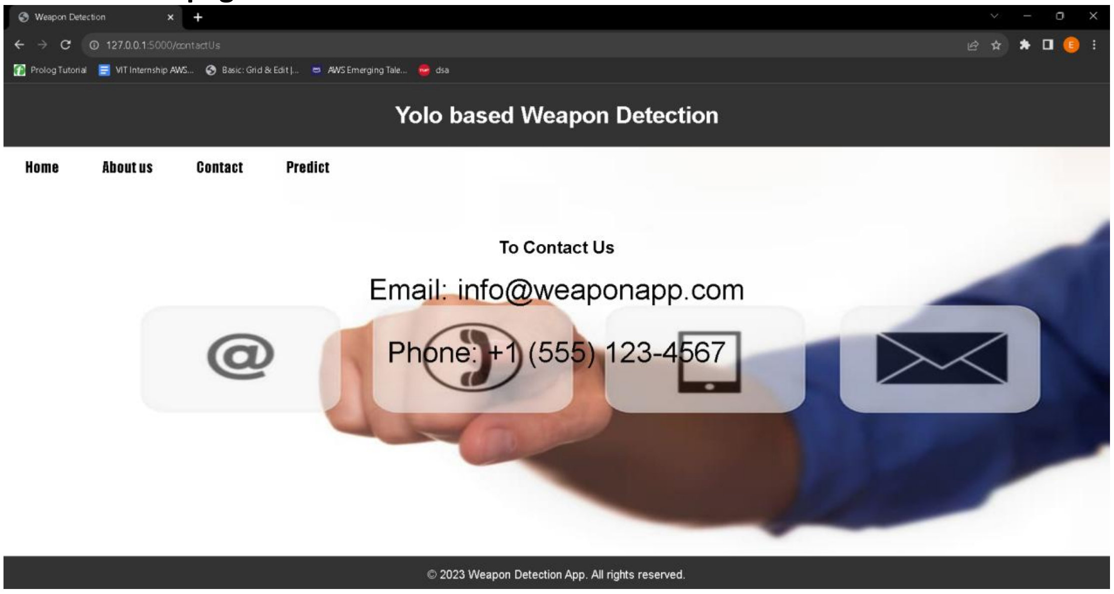
9.1.3 Contact page



Yolo based Weapon Detection

To Contact Us

Email: info@weaponapp.com

Phone: +1 (555) 123-4567

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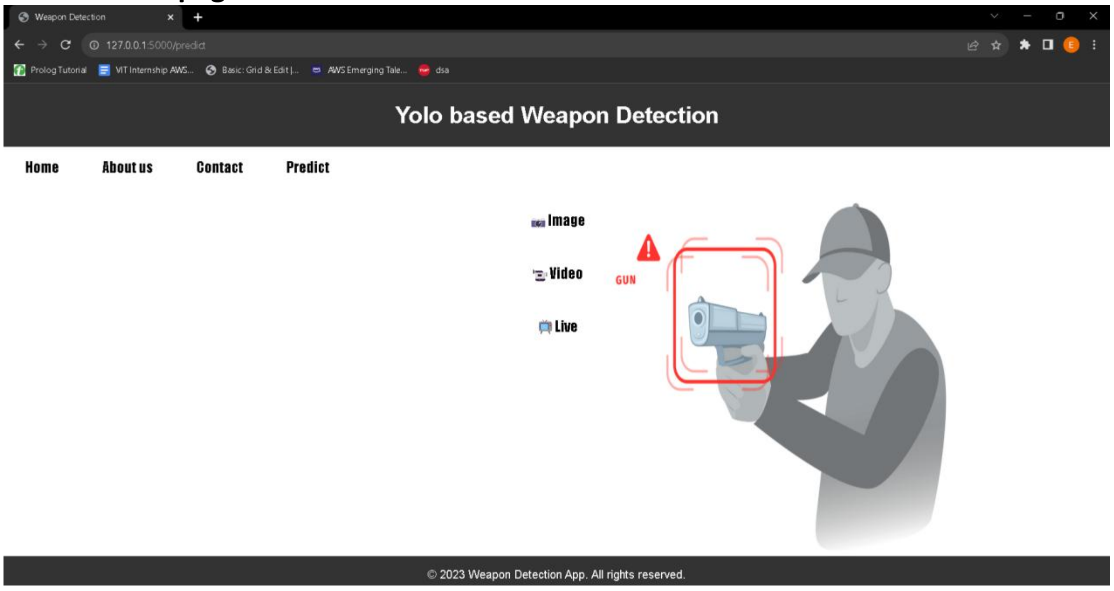
9.1.4 Predict page



Yolo based Weapon Detection

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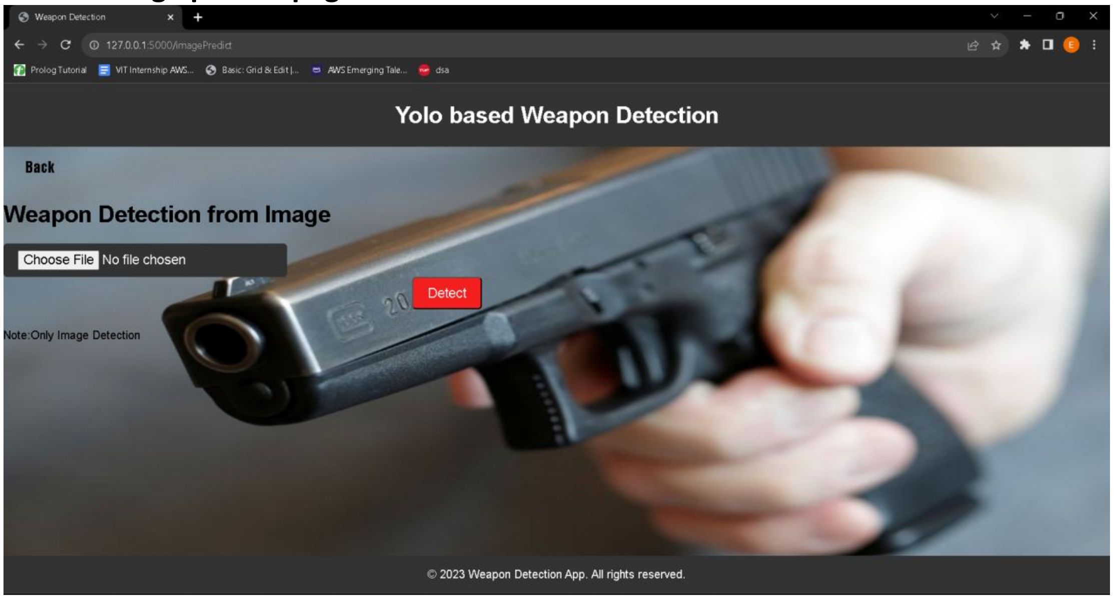
9.1.4.1 Image predict page


Weapon Detection
127.0.0.1:5000/imagePredict
Prolog Tutorial
VIT Internship AWS...
Basic: Grid & Edit |...
AWS Emerging Tale...
dsa
Yolo based Weapon Detection
Back
Weapon Detection from Image
Choose File
No file chosen
Detect
Note:Only Image Detection
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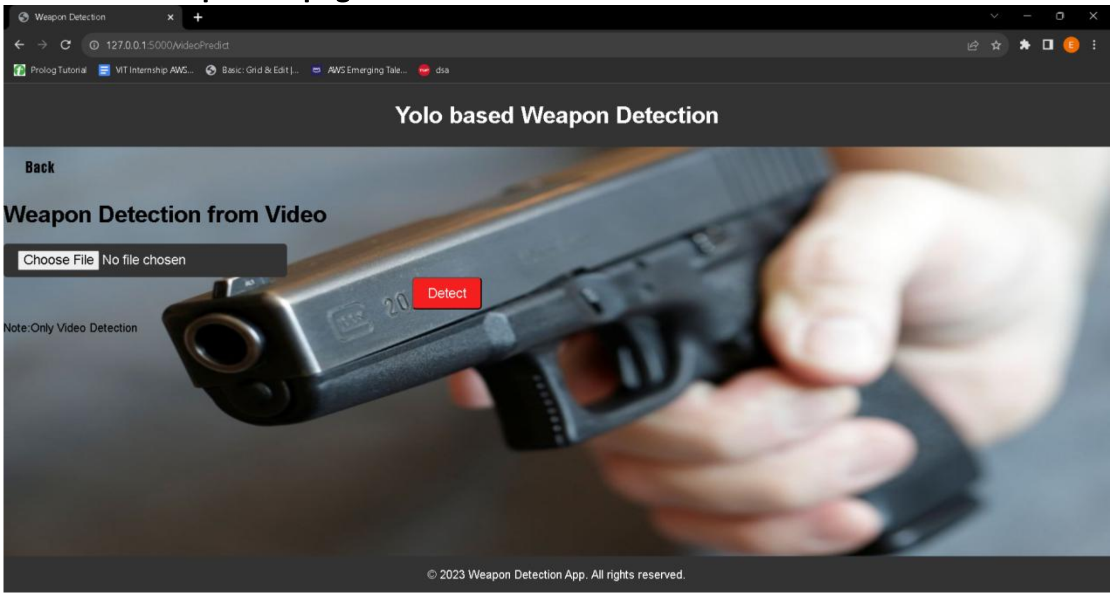
9.1..4.2 Video predict page


Weapon Detection
127.0.0.1:5000/videoPredict
Prolog Tutorial
VIT Internship AWS...
Basic: Grid & Edit |...
AWS Emerging Tale...
dsa
Yolo based Weapon Detection
Back
Weapon Detection from Video
Choose File
No file chosen
Detect
Note:Only Video Detection
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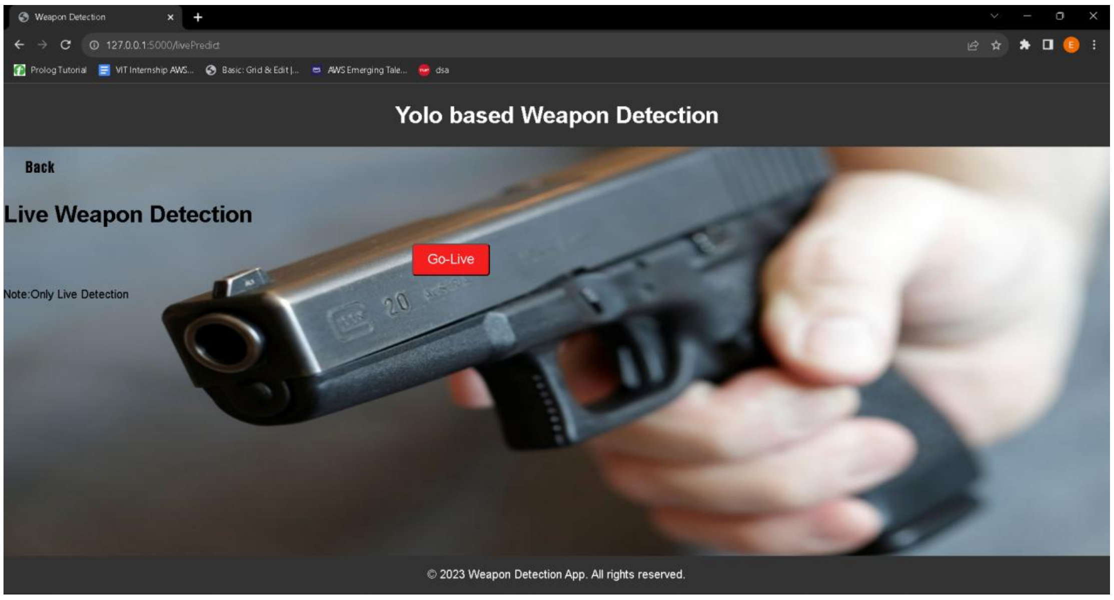
9.1..4.3 Live predict page



10. ADVANTAGES & DISADVANTAGES

Advantages of the "Arming Against Violence" System:

1. Enhanced Security:
- The system contributes to enhanced security by providing real-time detection of weapons, enabling timely responses to potential threats.
2. Rapid Threat Identification:
- Real-time object detection allows for the rapid identification of weapons, minimizing the risk of harm in public spaces.
3. Proactive Alert System:
- The alert mechanism promptly notifies security personnel, allowing for quick intervention and threat mitigation.
4. Scalability:
- The system is designed to be scalable, capable of covering large areas and adapting to varying environmental conditions.
5. Integration with Surveillance Cameras:
- Integration with surveillance cameras enhances coverage and provides a comprehensive security solution.
6. Privacy Considerations:
- Privacy measures are implemented to balance effective threat detection with individual privacy rights.
7. Continuous Monitoring:
- The system operates continuously, providing ongoing monitoring without interruptions to enhance overall security.
8. User-Friendly Interface:
- A user-friendly web interface facilitates system configuration and monitoring, making it accessible for security personnel.

Disadvantages and Challenges of the "Arming Against Violence" System:

1. False Positives and Negatives:
- The system may produce false positives or negatives, impacting accuracy. Ongoing model training and updates are necessary to address this.

2. Environmental Variations:
- Challenging environmental conditions, such as low-light scenarios or adverse weather, may impact the system's performance.
3. Resource Intensive:
- Real-time object detection and continuous monitoring can be resource-intensive, requiring powerful hardware and computational resources.
4. Privacy Concerns:
- Despite privacy measures, there may be concerns about the surveillance nature of the system, requiring transparent communication with the public.
5. Initial Implementation Costs:
- The initial implementation of the system, including hardware, software, and training, may involve significant costs.
6. Ethical Considerations:
- Ethical considerations related to surveillance, consent, and potential biases in object detection algorithms must be addressed.
7. System Maintenance:
- Ongoing maintenance is required to ensure the system's reliability, including software updates, hardware maintenance, and periodic checks.
8. Integration Challenges:
- Integrating the system with existing security infrastructure may pose challenges and require collaboration with relevant stakeholders.

It's important to note that while the system offers significant advantages in terms of security enhancement, the identified disadvantages highlight areas that require careful attention and continuous improvement throughout the system's lifecycle. Regular updates, user feedback, and advancements in technology can help address some of these challenges over time.

11. CONCLUSION

In conclusion, the "Arming Against Violence" project presents a proactive and intelligent approach to enhancing public safety and security through YOLO-based weapon detection. The system leverages cutting-edge computer vision technology to detect weapons in real-time, providing a rapid and effective response to potential threats. As with any complex system, there are both advantages and challenges that need to be considered.

In the journey towards creating a safer environment, the "Arming Against Violence" project acknowledges these challenges and is committed to continuous improvement. Regular updates, ongoing training of the detection model, and collaboration with stakeholders are essential for addressing emerging security needs.

As technology evolves, ethical standards are refined, and public expectations change, the "Arming Against Violence" project aims to remain adaptive and responsive to ensure the highest levels of security while respecting individual rights and privacy. The collaboration with security professionals, policymakers, and the community will be crucial in shaping the future development and deployment of this innovative security solution.

12. FUTURE SCOPE

The "Arming Against Violence" project lays the foundation for an intelligent and proactive security system, and its future scope is vast, offering opportunities for further development and enhancements. Here are potential directions for future advancements:

1. Integration with Advanced Technologies:
- AI Advancements: Leverage advancements in artificial intelligence and machine learning to further enhance object detection accuracy and speed.
- IoT Integration: Explore integration with Internet of Things (IoT) devices for a more interconnected and responsive security ecosystem.

2. Improved Detection Models:
- Continuous Training: Implement mechanisms for continuous model training using real-world data to adapt to evolving threats.
- Multi-Modal Detection: Explore the integration of multiple detection models to improve accuracy in diverse scenarios.

3. Geographic Expansion:
- Collaboration with Authorities: Collaborate with law enforcement agencies and public authorities to expand the system's deployment in key locations.
- Global Application: Adapt the system for global application, taking into account regional variations and legal considerations.

4. Enhanced Alert Mechanisms:
- Smart Alert Prioritization: Implement intelligent algorithms to prioritize alerts based on the severity of the threat and historical data.
- Integration with Emergency Services: Collaborate with emergency services to streamline responses and improve overall public safety.

5. Privacy-Centric Features:
- Privacy Enhancements: Incorporate advanced privacy-centric features, such as anonymization of data, to address privacy concerns.
- User-Controlled Settings: Provide users with more control over their data and the system's monitoring settings.

6. Community Engagement:
- Public Awareness Programs: Conduct awareness programs to inform the public about the system's purpose, capabilities, and privacy measures.
- User Feedback Integration: Actively seek and integrate feedback from the community to improve the system's acceptance and address concerns.

7. Mobile Application Integration:
- User-Friendly Mobile App: Develop a user-friendly mobile application for security personnel, allowing them to monitor alerts and manage system settings remotely.
- Citizen Involvement: Enable citizen involvement through a mobile app, providing a

platform for reporting and emergency communication.

8. Energy Efficiency and Sustainability:
- Optimized Resource Usage: Implement optimizations for resource usage to enhance energy efficiency and sustainability.
- Green Technology Adoption: Explore the use of green technologies and energy-efficient hardware components.

9. Research Collaboration:
- Collaborative Research: Collaborate with research institutions and universities to stay at the forefront of security technology advancements.
- Open Source Contributions: Contribute to open-source projects to foster collaboration and knowledge sharing within the research community.

10. Adaptation to Emerging Threats:
- Threat Intelligence Integration: Integrate threat intelligence feeds to stay informed about emerging threats and adapt the system accordingly.
- Scenario-Specific Adaptations: Develop mechanisms to dynamically adapt to specific threat scenarios and tactics.

The future scope of the "Arming Against Violence" project is expansive, providing opportunities for innovation, collaboration, and the continuous improvement of security measures to create safer and more secure environments. As the project evolves, staying abreast of technological advancements and engaging with stakeholders will be essential for its long-term success.

13.Appendix

13.1.Source Code

```
from ultralytics import YOLO
import cv2
import cvzone
import math
from playsound import playsound
import time
import pygame
import threading
model = YOLO(r"D:\code\aiexperiments\finalProject\trainedVersions\400epoch\weights\best.pt")

pygame.mixer.init()
```

```
video = cv2.VideoCapture(0)
```

```
def play_alert_sound():
```

```python
    # Play a simple alert sound using pygame
    pygame.mixer.music.load('alarm.mp3')  # Replace
'alert_sound.wav' with your sound file
    pygame.mixer.music.play()
    time.sleep(5)  # Adjust duration as needed
    pygame.mixer.music.stop()
```

```python
def async_play_alert_sound():
    # Run the play_alert_sound function in a separate thread
    alert_thread = threading.Thread(target=play_alert_sound)
    alert_thread.start()
    # time.sleep(5)
```

```python
def detect():
    isSoundPlaying = False
    weapon = False
```

```python
    while True:
        data, frame = video.read()
        res = model(frame, stream=True)
        for r in res:
            boxes = r.boxes
            for box in boxes:
              #bounding box
              x1,y1,x2,y2 = box.xyxy[0]
              x1,y1,x2,y2 = int(x1),int(y1),int(x2),int(y2)
              w,h = x2-x1,y2-y1
              cvzone.cornerRect(frame,(x1,y1,w,h))
            #   confidence
              conf = math.ceil((box.conf[0]*100))/100
              #className
              cls = int(box.cls[0])
              cvzone.putTextRect(frame,f'{model.names[cls]}
{conf}',(max(0,x1),max(35,y1)),scale=0.7,thickness=1)
              if conf >= 0.7:
                  weapon = True
                  async_play_alert_sound()
        cv2.imshow("image",frame)
        cv2.waitKey(1)
```

```python
detect()
```

13.2.GitHub and Demo Project Link

13.2.1Github Link

https://github.com/smartinternz02/SI-GuidedProject-611320-1699524079

13.2.2.Project Demo Link

https://drive.google.com/file/d/1lxfnGUfk3NCGMzJ7VAU-WB0J1_qNdpNS/view?usp=sharing