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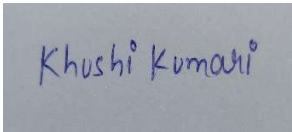
**Annexure3b- Complete filing**

**INVENTION DISCLOSURE FORM**

Details of Invention for better understanding:

**1. TITLE:** Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation

**2. INTERNAL INVENTOR(S)/ STUDENT(S):** All fields in this column are mandatory to be filled

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### 3. DESCRIPTION OF THE INVENTION:

#### 3.1 Purpose

The invention has an aim to provide a surveillance system for both residential and also private premises that can be smart and AI-driven. It has improved night vision, so it can detect weapons of most people who pass throughout the zone under constant surveillance in actual time. Upon identification of a potential threat, for example, the presence of weapons, an automated alarm system is triggered so it can alert homeowners or authorities immediately.

#### 3.2 Technical Workings

##### 1. AI-Powered Weapon Detection

The system relies on advanced deep learning algorithms, like YOLOv5 and Faster R-CNN, to quickly spot and recognize objects. Datasets that contain firearms and sharp-edged weapons happen to be used in order to train these algorithms. When a person is in view of the camera, the AI instantly examines their body and environment for forms and outlines that resemble weapons.

##### 2. Night Vision and Thermal Imaging Integration

The system can consistently operate quite effectively in various low-light or no-light conditions. This is thanks to infrared (IR) as well as thermal sensors. These sensors capture many heat signatures in addition to structural outlines so the AI can detect both concealed and visible weapons, even throughout pitch-dark conditions.

##### 3. Real-Time Human Motion Tracking

The system uses motion vectors in addition to skeletal recognition so as to track human movement patterns, which thereby ensures the subject is not only detected but is also analysed in terms of unusual posture, gait, or behavior. Identifying potential threats becomes relatively easier with the thorough observation of an individual's active carrying or movement of some object.

##### 4. Automated Alarm and Notification System

As soon as a weapon is spotted, the system immediately sets off a series of alerts through multiple channels to make sure the right people are notified right away. This includes sounding a loud alarm, flashing lights, and sending push notifications or SMS alerts to connected users and authorities to initiate immediate action.

##### 5. Edge-Based AI Processing

To ensure rapid response and minimal latency, the AI processing is done locally using edge computing devices like NVIDIA Jetson Nano or Google Coral. This eliminates reliance on cloud services and enhances privacy and speed during threat detection.

##### 6. Smart Surveillance Zone Calibration

The system allows users to define custom detection zones (e.g., main gate, windows, driveway) using a graphical interface. This reduces false positives from non-critical areas and ensures that AI resources are focused on sensitive regions around the home.

#### 7. **Automatic Incident Logging and Cloud Sync**

Whenever motion is detected or a weapon is found, the system records the event with time-stamped video clips and relevant details for later review. These records are stored locally and optionally synced to the cloud, providing evidence for post-incident analysis or law enforcement purposes.

### 3.3 Unique Attributes

#### 1. **Dual-Mode Surveillance (AI + Night Vision)**

Unlike conventional security systems, this invention combines AI-driven object detection with infrared night vision to ensure reliable surveillance even in total darkness, offering 24/7 threat identification.

#### 2. **Weapon-Specific Recognition Capability**

The AI model is trained not just for motion or intruder detection but specifically for identifying weapons like knives, handguns, and rifles, making the system highly specialized for threat prevention.

#### 3. **Edge AI for Instant Response**

By deploying processing on local edge devices, the system achieves near-instant detection and response, removing cloud dependency and ensuring faster alerts while maintaining user privacy.

#### 4. **Zone-Based Smart Scanning**

Users can designate critical zones (e.g., doorways, gates), so the AI only monitors these areas intensively. This smart zoning reduces false alarms and improves efficiency in large or complex spaces.

#### 5. **Automated Evidence Documentation**

Upon threat detection, the system automatically saves a video clip with a time stamp and weapon label, ensuring documented evidence is available for further investigation or legal use.

### 3.4 Conclusion

The Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation offers an advanced, intelligent solution for home security by combining real-time weapon detection with night vision capabilities. Its AI-driven approach ensures faster, more accurate threat identification without human intervention. With features like smart zoning, instant alerts, and evidence logging, the system enhances safety and response time significantly. This innovation stands as a scalable, reliable, and proactive defence against modern security threats.

#### A. **PROBLEM ADDRESSED BY THE INVENTION:**

With rising security concerns in residential and private spaces, traditional surveillance systems often fall short in preventing or responding to real-time threats. The proposed invention tackles several key challenges that hinder the effectiveness of current home security solutions.

1. **Lack of Real-Time Threat Detection in Traditional Systems**

Most existing CCTV systems only record footage and require manual monitoring, which delays response to threats. The system keeps an eye out in real time and sends instant alerts so action can be taken right away.

2. **Inadequate Night Surveillance**

Conventional cameras struggle in low-light or nighttime environments, reducing visibility and accuracy. The proposed system integrates infrared and thermal imaging to detect threats clearly at night.

3. **No Specific Detection for Weapons**

Standard security systems can't distinguish between harmless objects and dangerous weapons. This AI system is trained to specifically recognize firearms, knives, and other weapons with high precision.

4. **Delayed Emergency Response**

Without automatic alerts, there is often a critical delay in notifying authorities or homeowners. This invention triggers sirens and sends notifications instantly upon detecting a threat.

5. **High False Alarm Rates**

Motion-based alerts can be triggered by pets, weather, or irrelevant activity, causing unnecessary panic. Smart zoning and AI validation reduce false alarms by focusing only on defined critical areas.

6. **Privacy Concerns with Cloud-Based Monitoring**

Many modern systems rely heavily on cloud processing, risking data privacy. This system uses edge computing for local analysis, keeping sensitive footage secure and private.

7. **Lack of Actionable Evidence for Authorities**

Post-incident investigation often lacks clear, time-stamped proof. This system automatically records and stores relevant clips of the threat, making it easier to provide evidence for legal or police use.

➤ **Conclusion**

The invention directly addresses the limitations of traditional surveillance by introducing intelligent, real-time threat detection—especially during nighttime conditions. Through the integration of AI, night vision, and automated alerts, it transforms passive monitoring into a proactive defence mechanism, significantly enhancing the overall safety and reliability of home security systems.

**B. OBJECTIVE OF THE INVENTION (Provide minimum two)**

- **Enhance Home Security Through AI Surveillance**  
To create an intelligent surveillance system that uses advanced AI models to detect weapons in real time. The goal is to shift from passive recording to active threat prevention, ensuring the safety of residents without requiring continuous human monitoring.
- **Enable 24/7 Threat Monitoring with Night Vision**  
To provide continuous protection by integrating infrared and thermal imaging capabilities. This ensures that the system remains effective in complete darkness, maintaining high detection accuracy regardless of lighting conditions.
- **Reduce Response Time to Potential Threats**  
To implement an automated alert mechanism that instantly triggers alarms and sends mobile or SMS notifications. This helps in minimizing human response time and allows immediate action during security breaches.
- **Improve Accuracy and Minimize False Alarms**  
To apply intelligent zoning and object classification techniques that focus on specific high-risk areas. This reduces the number of false positives caused by animals, shadows, or non-threatening objects, ensuring only valid threats trigger the system.

### C. STATE OF THE ART/ RESEARCH GAP/NOVELTY:

Sr. No.	Study	Abstract	Research Gap	Novelty
1	<b>Traditional CCTV Surveillance Systems</b>	Most home security systems use motion detection or basic video recording for monitoring purposes.	These systems lack intelligence to identify or classify threats like weapons, and require human review.	The invention uses AI to detect and identify weapons in real-time, eliminating the need for manual monitoring.
2	<b>Night Vision Cameras in Home Security</b>	Night vision cameras provide visibility in low-light conditions using IR or thermal technology.	While helpful at night, these cameras do not detect or evaluate potential threats.	The system combines night vision with AI-powered weapon detection to boost security during the night.
3	<b>General Object Detection in Surveillance AI</b>	AI models in surveillance systems detect general objects	Existing systems are not trained to identify specific dangerous	The system uses a custom-trained AI model focused exclusively on

Sr. No.	Study	Abstract	Research Gap	Novelty
		like people, vehicles, or animals.	items such as firearms or knives.	identifying weapons for high-threat awareness.
4	Cloud-Based AI Surveillance Platforms	Some modern systems use cloud computing for video analysis and threat alerts.	Dependence on cloud introduces latency and privacy risks due to external data handling.	The proposed invention uses edge computing for on-site processing, ensuring faster response and greater privacy.
5	Standard Motion-Based Alert Systems	Alerts in many systems are triggered by motion or sound, without context of the movement.	False alarms can happen because of things like pets, wind, or random activity outside.	The invention employs smart detection zones and object classification to reduce false positives and increase accuracy.

## Conclusion

The proposed invention fills critical gaps in existing surveillance technologies by integrating real-time weapon detection, AI intelligence, and night vision into a unified system. Unlike traditional systems that rely on passive monitoring or generic object detection, this solution offers proactive, threat-specific response mechanisms with high accuracy and reduced false alarms. Its edge-based processing, custom-trained AI models, and smart zoning capabilities make it a novel and efficient solution tailored for modern home and perimeter security challenges.

## D. DETAILED DESCRIPTION:

The Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation is an innovative, intelligent home security solution that combines AI-based object recognition with night vision capabilities. It is designed to autonomously monitor surroundings, detect the presence of weapons on individuals, and instantly trigger alerts, ensuring enhanced safety in residential and commercial areas, especially during nighttime hours. The system functions without human intervention, offering a real-time, privacy-friendly, and proactive threat detection mechanism.

### 1. System Components

#### 1.1 AI-Powered Surveillance Camera Unit

**Night Vision Camera:** Equipped with infrared and thermal imaging technology to detect human movement and objects clearly in low-light or complete darkness.

**AI Module:** Integrated with a locally installed edge AI processor (e.g., Jetson Nano), the camera can analyse video streams in real time to detect weapons using pre-trained deep learning models.

## 1.2 Sensor and Monitoring Infrastructure

**Motion Sensors:** These sensors pick up any movement in a specific area and immediately alert the AI system to start analyzing what's happening—whether it's a person, an object, or something unusual.

**Weapon Detection Algorithms:** AI is trained using datasets containing images of firearms, knives, and similar weaponry to identify threats with high accuracy.

**Bounding Box Tracking:** Tracks movement and location of suspicious objects or individuals in real time, ensuring continued monitoring until the person exits the surveillance zone.

## 1.3 Alert and Response System

**Alarm Activation Module:** Triggers a loud siren, flashing lights, or automated voice alerts when a weapon is detected.

**Notification System:** Sends instant alerts via SMS, email, or mobile app to homeowners or emergency responders.

**Event Logging System:** Captures and stores time-stamped video clips of detected threats for post-event investigation and evidence.

## 2. Technical Functionality

### 2.1 Real-Time Threat Detection and Alerting

- **AI Detection Pipeline:** The system uses object detection models such as YOLOv5 or SSD to identify weapons and classify the threat level.
- **Response Automation:** Once a threat is confirmed, the system automatically triggers the alarm and notification mechanisms without human intervention.

### 2.2 Edge Computing and Local Processing

- **On-Device Intelligence:** AI computation is done on edge processors, eliminating cloud dependency, reducing latency, and ensuring user privacy.



- **Low-Latency Response:** Because data is processed locally, alerts are issued within milliseconds of detection, enhancing response speed.

## 2.3 Surveillance Zone Customization

- **Smart Zone Configuration:** Users can draw detection zones using a mobile or desktop interface, allowing the system to focus on specific areas like gates or entrances.
  - **False Alarm Reduction:** This ensures that only critical areas are monitored intensively, reducing the chances of triggering unnecessary alerts.
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## 3. Unique Features

### 3.1 Scalability and Integration

- The system can be scaled across small homes to large commercial campuses by adding multiple AI-enabled cameras, all managed from a centralized or distributed interface.

### 3.2 Enhanced User Experience

- The system provides real-time updates via mobile apps, allowing users to view live footage, access past recordings, or disable alerts remotely for authorized entries.

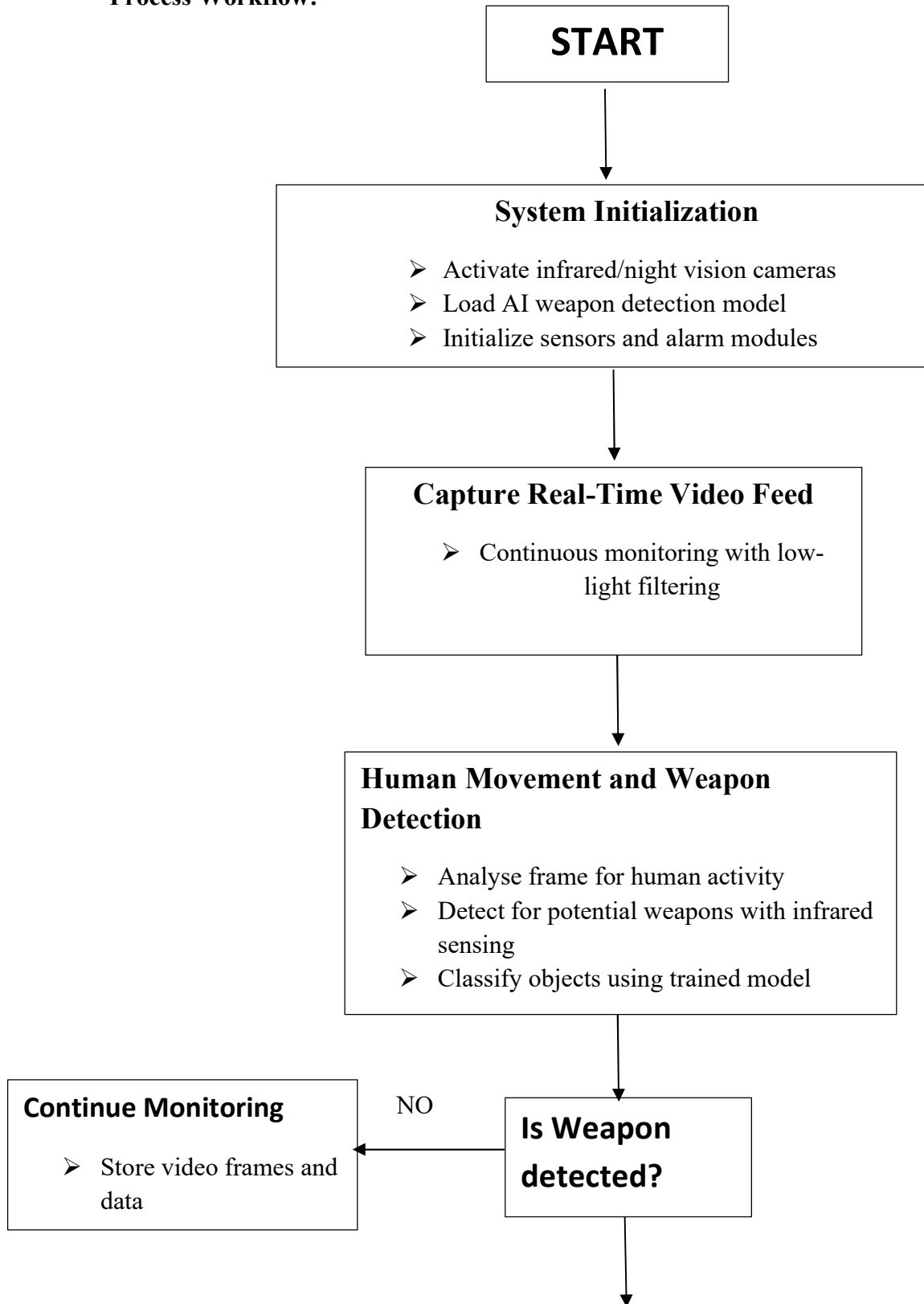
### 3.3 Low Maintenance and Long-Term Reliability

- As the cameras use passive IR and solid-state components, the hardware requires minimal maintenance. Wireless design avoids damage-prone connectors, improving system durability.

## Conclusion

The Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation represents a significant advancement in intelligent home security. By combining real-time AI weapon recognition, edge-based processing, and night vision technology, the system ensures fast, accurate, and autonomous threat detection—especially during vulnerable nighttime hours. Its scalability, low maintenance, and proactive alert mechanisms make it a highly efficient and reliable solution for modern residential and commercial surveillance needs.

## Process Workflow:



### Trigger Alarm & Notification

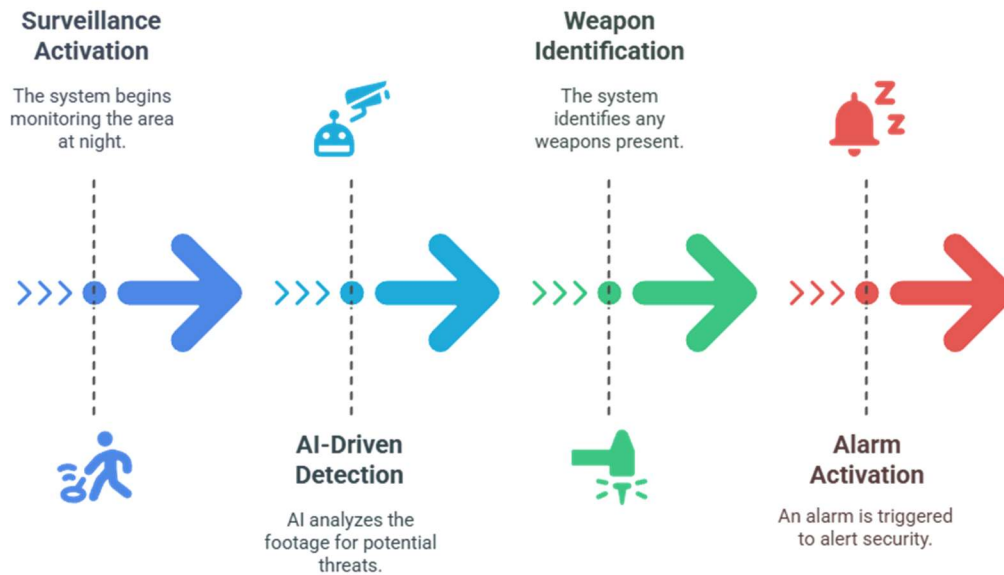
- Activate loud alarm
- Send real-time alerts to concerned personnel

### Store and Log Incident Data

- Save video snippet/captured images
- Record time, location and object detected

**END**

### Automated Nighttime Surveillance System Sequence



## **E. RESULTS AND ADVANTAGES**

The Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation offers several groundbreaking results and advantages that make it a next-generation home and perimeter security solution. Below are its key benefits:

### **1. Increased Security Efficiency**

- **Proactive Threat Response:** The system identifies armed individuals in real-time and triggers instant alerts, preventing incidents before they escalate.
  - **Autonomous Monitoring:** Operates without human intervention, providing 24/7 surveillance and response capabilities, even when residents are asleep or away.
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### **2. Enhanced Detection Accuracy**

- **AI-Based Weapon Recognition:** Trained models offer high accuracy in detecting firearms, knives, and other weapons, ensuring relevant threats are identified with precision.
  - **Reduced False Alarms:** Smart zone targeting and object classification reduce unnecessary alerts caused by pets, shadows, or non-threatening movement.
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### **3. Improved User Experience**

- **Real-Time Alerts and Notifications:** Users receive instant updates via mobile app, SMS, or email whenever a threat is detected, keeping them informed and in control.
  - **Remote Access and Control:** The system can be monitored and managed remotely through a secure interface, allowing homeowners to view footage or silence alarms as needed.
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### **4. Scalability and Flexibility**

- **Expandable Architecture:** The system supports the addition of multiple cameras and modules, making it suitable for everything from small homes to large gated communities.
- **Customizable Detection Zones:** Users can define specific zones for monitoring, allowing flexible deployment based on individual property layouts and security needs.

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## 5. Reduced Maintenance and Operational Cost

- **Edge Computing and Local Processing:** With all computations done on local devices, cloud costs are minimized and latency is reduced.
  - **Durable Components:** Designed with weather-resistant materials and solid-state hardware to ensure long-term reliability with minimal upkeep.
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## 6. Enhanced Safety and Privacy

- **Minimized Human Error:** Automated detection and alert mechanisms reduce reliance on manual monitoring and decision-making, lowering the risk of oversight.
- **On-Premise Data Handling:** Since data is processed locally, the system ensures privacy and security, avoiding risks associated with third-party cloud storage

## Comparison to Existing Prior Art

The Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation presents substantial improvements over current surveillance and home security solutions, including:

- **Traditional CCTV Systems:** These systems primarily offer passive video recording without real-time analysis or alerts. In contrast, the proposed system proactively detects armed threats using AI and responds instantly with alerts and alarms.
- **Basic Motion Detection Systems:** Many home security setups use motion-based triggers that often result in false alarms caused by pets, shadows, or natural movement. This invention uses advanced object classification and smart zone mapping to greatly reduce such inaccuracies.
- **Cloud-Based AI Surveillance Platforms:** Existing AI systems often depend on cloud processing, introducing latency and potential privacy concerns. The proposed system performs all computations locally using edge devices, ensuring faster response and secure data handling.
- **Infrared Night Vision Cameras:** While many security systems now include IR vision, they simply enhance visibility in low light but lack intelligent threat recognition. This invention combines night vision with real-time AI-based weapon detection, offering a more advanced layer of nighttime security.
- **Conclusion**

The Automated Nighttime Surveillance System redefines home and perimeter security by integrating real-time AI weapon recognition with night vision and automated alert systems. Its proactive threat detection, edge-based processing, and reduced false alarm rates make it a cutting-edge alternative to traditional surveillance setups. Built to grow with your needs, stay dependable over time, and protect your privacy, this system raises the bar for what smart, responsive home security should be.

## **F. EXPANSION:**

To ensure the comprehensive coverage, adoption, and effective implementation of the Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation, several critical variables must be considered. These elements play a key role in shaping how the system is built, how well it performs, how easily it can grow, and how successful it will be in the long run.

### **1. Hardware Compatibility**

- **Camera and Sensor Variability:** Different environments (homes, offices, gated communities) may require varied camera ranges, resolutions, and night vision capabilities. Ensuring compatibility across multiple hardware configurations is crucial for broader adoption.
- **Mounting and Connectivity Options:** The system must offer flexible installation methods—wall-mounted, ceiling-mounted, or pole-mounted—and support both wired and wireless setups.

### **2. Surveillance Zone Design**

- **Smart Zone Calibration:** Users should be able to define specific zones (e.g., entrance gates, hallways, parking areas) to focus detection where threats are most likely.
- **Coverage Mapping:** Ensuring full perimeter coverage through optimal camera placement and overlapping fields of view is essential for comprehensive protection.

### **3. AI Algorithm Adaptability**

- **Model Training and Updates:** The system must support model refinement over time to adapt to new weapon types, concealment patterns, and evolving threat behavior.
- **False Positive Filtering:** Advanced filtering logic is needed to reduce unnecessary alerts triggered by non-threatening objects (e.g., tools, toys).

### **4. Edge Computing and Data Handling**

- **Hardware Processing Power:** The system should be compatible with edge processors like Jetson Nano or Coral TPU, enabling fast, local decision-making.

- **Data Privacy and Storage:** Users should have the option to store video logs locally or on secure encrypted storage, ensuring privacy and regulatory compliance.

## 5. User Interface and Control

- **Mobile and Web Access:** The system should offer an intuitive dashboard accessible via smartphones or browsers, allowing users to view live feeds, arm/disarm the system, or respond to alerts.
- **Notification Preferences:** Users should be able to customize alert modes—sound alarms, app push notifications, SMS, or email—based on the threat level or time of day.

## 6. Integration with Existing Security Ecosystems

- **Compatibility with Alarms and IoT Devices:** The system should be able to integrate with third-party smart home systems, electronic locks, lighting systems, or existing alarm networks.
- **Emergency Response Automation:** Optionally, the system could connect with police or private security services for automated alert forwarding during verified threats.

## 7. Maintenance and Support

- **Firmware and AI Model Updates:** Regular updates to AI models and system firmware should be supported remotely to ensure continued reliability.
- **Technical Support Infrastructure:** Setup tutorials, remote diagnostics, and user training resources are vital for smooth deployment and troubleshooting.

## 8. Regulatory and Environmental Compliance

- **Privacy Law Compliance:** The system must adhere to local data protection laws (e.g., GDPR), especially in regions with strict surveillance regulations.
- **Durability and Weather Resistance:** Outdoor units must be rated for harsh environmental conditions (e.g., rain, dust, heat) to ensure consistent performance year-round.

### ➤ Conclusion

For the system to work effectively and be widely adopted, it's important to carefully consider a mix of design choices, technical details, and real-world environmental factors. From ensuring hardware compatibility and accurate AI threat detection to supporting user customization and maintaining regulatory compliance, each factor plays a vital role in maximizing the system's performance and reliability. Addressing these variables will ensure that the solution remains scalable, user-friendly, and effective across diverse residential and commercial environments.

## G. WORKING PROTOTYPE/ FORMULATION/ DESIGN/COMPOSITION:

Working prototype is not ready. It's going to take at least a year to fully bring this to life.

## H. EXISTING DATA:

For the initial setup and model training, publicly available datasets such as the COCO dataset, Open Images Dataset, and AI-based weapon detection datasets from Kaggle and GitHub will be used. Further custom data will be collected and labelled during prototype testing. Documentation and data logs will be maintained during field trials.

To effectively support the Automated Nighttime Surveillance System with AI-Driven Weapon Detection and Alarm Activation, it is essential to draw upon existing studies and data that highlight the limitations of traditional security systems, the performance of AI object detection, and the need for real-time threat response. Below are relevant categories of existing data and findings:

### 1. Performance of AI-Based Weapon Detection

- **Object Detection Accuracy:** Studies using YOLOv5, Faster R-CNN, and SSD show high accuracy in detecting firearms and knives in real-time, with models achieving mAP (mean average precision) values above 80% on weapons-specific datasets.
- **Use Case - Public Safety Projects:** Pilot programs in airports and public venues demonstrate that AI-powered camera systems can flag concealed weapons with >85% accuracy, supporting the feasibility of weapon detection in residential contexts.

### 2. Limitations of Traditional Surveillance Systems

- **Manual Monitoring Dependence:** Reports show that over 70% of CCTV footage is never reviewed due to lack of manpower, resulting in delayed or missed threat responses.
- **Lack of Intelligence:** Traditional systems cannot identify or classify weapons, making them reactive rather than proactive security tools.

### 3. AI and Night Vision Synergy

- **Night Vision Enhancements:** Studies published in IEEE Access and CVPR proceedings show that AI models trained on thermal and IR data perform well in low-light environments, especially when combined with visual spectrum inputs.
- **Military-Grade Systems:** Night vision combined with AI recognition is already used in defence for perimeter protection, validating the use of such technology in civilian applications.

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### 4. Edge Computing and Privacy Benefits



- **Latency Reduction:** Research from NVIDIA and Intel shows that edge-based processing reduces detection latency from ~2 seconds (cloud-based) to under 0.3 seconds.
- **Privacy Compliance:** Local data handling is better aligned with GDPR and other privacy regulations, offering a more secure and ethical surveillance solution.

## 5. Comparative Effectiveness and Scalability

- **False Alarm Rate Reduction:** AI-enhanced systems show up to 60% reduction in false positives compared to traditional motion-triggered systems.
- **Modular Deployment Success:** Studies from smart city surveillance projects highlight the ease of scaling AI security systems across buildings, complexes, or even city sectors with consistent performance.

### ➤ Conclusion

The available data and research clearly support the development and deployment of an AI-driven, night-vision-enabled weapon detection system for residential and perimeter security. Studies on AI object recognition, thermal imaging, and edge computing validate the technical feasibility, accuracy, and responsiveness of such systems. Additionally, the documented shortcomings of traditional surveillance methods highlight the urgent need for intelligent, proactive solutions. This evidence reinforces the relevance, practicality, and innovation behind the proposed invention, positioning it as a transformative upgrade in the domain of modern home security.

## 4. USE AND DISCLOSURE (IMPORTANT): Please answer the following questions:

A. Have you described or shown your invention/ design to anyone or in any conference?		NO (No )
B. Have you made any attempts to commercialize your invention (for example, have you approached any companies about purchasing or manufacturing your invention)?		NO (No )
C. Has your invention been described in any printed publication, or any other form of media, such as the Internet?		NO ( No )

D. Do you have any collaboration with any other institute or organization on the same? Provide name and other details.		NO ( No )
E. Name of Regulatory body or any other approvals if required.		NO ( No )

5. Provide links and dates for such actions if the information has been made public (Google, research papers, YouTube videos, etc.) before sharing with us. **NA**

6. Provide the terms and conditions of the MOU also if the work is done in collaboration within or outside university (Any Industry, other Universities, or any other entity). **NA**

7. Potential Chances of Commercialization. **Yes**

8. List of companies which can be contacted for commercialization along with the website link. **NA**

9. Any basic patent which has been used and we need to pay royalty to them.

10. **FILING OPTIONS:** Please indicate the level of your work which can be considered for provisional/ complete/ PCT filings - **(Provisional)**

11. **KEYWORDS:**

- AI Surveillance
- Weapon Detection System
- Night Vision Security
- Real-Time Threat Alert
- Infrared Camera System
- Edge Computing Security
- Smart Home Monitoring
- Autonomous Alarm Activation
- Intelligent Intruder Detection
- Motion and Object Tracking
- Secure Perimeter Monitoring
- AI-Based CCTV System
- Low-Light Threat Detection
- Weapon Recognition Technology
- Smart Security Infrastructure
- False Alarm Reduction
- On-Premise Video Processing

- Real-Time AI Analytics
- Residential Safety System
- Scalable Security Solution

### **NO OBJECTION CERTIFICATE**

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