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SKY GUARDIAN: ANTI-HARASSMENT DRONE PATROL

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Abstract : *The Sky Guardian: Anti-Harassment Drone Patrol project aims to develop a drone system for enhancing women' s safety in emergency situations. When a woman presses an SOS button, her location is instantly sent to the drone via GPS. The drone autonomously files to the victim's location using real-time navigation. Upon arrival, it uses sensors and computer vision to detect the number of people present. Based on the situation, it either deploys a stun gun for a single attacker or releases non-lethal toxic gas like pepper spray for multiple threats. The drone also activates sirens and lights to attract public attention. Live video streaming to authorities ensures quick emergency response. The system combines GPS tracking, threat detection, and automated defense mechanism. It offers rapid intervention and deterrence against potential assaults. The project presents a smart and tech-driven approach to women's safety.*

Keywords - Anti-harassment surveillance, Drone patrol, AI-based behavior analysis, Toxic gas detection

I. INTRODUCTION

Women's safety remains a pressing concern in many parts of the world, with incidents of harassment, assaults and violence contributing to rise. Despite various awareness campaigns and safety measures, there is still a significant need for rapid-response technologies that can provide immediate assistance in times of danger. In this context, the integration of autonomous drone technology offers a promising solution. This project proposes a smart drone-based safety system designed specially to respond to emergency situation faced by women. The core idea revolves around empowering women with the ability to call for help by simply pressing an SOS button on a wearable device or mobile application. This action triggers the transmission of the victim's GPS location to a re-deployed drone stationed nearby. The drone, coordinates without requiring manual control. Once the drone reaches the victim's location, it utilizes onboard sensors and computer vision algorithms to analyze the number of individuals present. Based on this assessment, the drone activates the appropriate self-defense mechanism. For a single attacker, a stun gun can be deployed to incapacitate the threat temporarily. In scenarios involving multiple potential attackers, the drone releases a nom-lethal toxic gas, such as pepper spray, to disperse the crowd and provide the victim with a chance to escape. To further enhance its effectiveness, the drone is also equipped with loud sirens, flashing lights, and live video streaming capabilities. These features not only help draw public attention but also allow real-time monitoring by law enforcement or emergency responders. The integration of threat detection, GPS for accurate navigation, and non-lethal counter measures ensures that the drone acts quickly and responsibly without causing excessive harm. This project aims to deliver a practical, scalable, and technologically advanced solution to enhance women's safety in urban and remote areas. By combining modern drone technology with real-time communication and intelligent defense systems, it aspires to serve as both a deterrent to attackers and a life-saving tool for potential victims.

II. LITERATURE SURVEY

"Women Safety Patrolling Drone Using Machine Learning, IoT and Cloud Computing" proposes a novel safety system for women by integrating a wearable smart band, drones, machine learning, and cloud infrastructure: when the wearer's heart rate exceeds a threshold (indicating fear), the band sends a signal via mobile GPRS to trigger the nearest drone, which navigates using GPS, live-streams video to a control center, distinguishes between the wearer and a potential threat using ML on cloud- hosted data, and can deploy a non-lethal fainting spray to incapacitate the attacker until help arrives; the system also requires users to create profiles to help in identification and ensures automated, real-time response to distress, aiming to enhance proactive protection and rapid intervention.

"A Research Paper on Women Safety Device with Stun Gun" presents a low-cost, IoT-enabled safety device aimed at empowering women by integrating a Raspberry Pi-based module with biometric and environmental sensors (heart rate, body temperature, voice detection) to monitor distress conditions; when triggered, the system sends real-time alerts — including GPS location and recorded data — to preset emergency contacts via SMS, while also activating a built-in stun-gun mechanism for self-defense, thereby combining personal health monitoring, communication, and non-lethal deterrence to enhance women's security in vulnerable scenarios.

"Women Drone Security System" proposes a comprehensive security system for women that integrates a mobile application and an autonomous drone: the app continuously listens for a distress-voice cue (such as a scream) and upon detection, sends a real-time alert—including the victim's GPS location—to both emergency contacts (police and family) and a nearby drone. The drone, operating within approximately 1 km range, then launches and flies to the victim's location where it triggers an audible siren, records video evidence, uses face-scanning to identify possible attackers, and deploys a non-lethal deterrent (laser, spray, or similar) to incapacitate the threat until help arrives. The system is aimed at improving rapid-response capability and strengthening women's safety infrastructure by combining voice-activated mobile sensors, navigation, live video, and proactive aerial defense.

"Adoption of Drone Technology for the Smart Safety Mechanism of Women" proposes an autonomous drone system designed as a "smart safety mechanism" for women, particularly during night-time hours. The system is conceptualized as a "flying Detective Machine" built around a PixHawk 2.4.8 flight controller. It utilizes a camera feed processed by machine learning, specifically mentioning the Fast R-CNN algorithm for analyzing pedestrian actions and a LipGAN framework to detect keywords like "Help" or "Kill" from lip movements. Upon detecting a "mischievous activity," the drone is designed to use a SIM900A GSM module to automatically send images of the incident, along with the drone's GPS coordinates, to the nearest police department or hub to facilitate a rescue. The author suggests this drone-based solution is more robust than smartphone apps, which are dependent on a user's device being functional and in their possession.

"Drone Patrolling Applications, Challenges, and its Future: A Review" by Hesham Ahmed Abas and Nazri Nasir presents a comprehensive literature review of unmanned aerial vehicles (UAVs) used for patrolling tasks—highlighting how drone-based systems offer improved coverage, speed, and cost-effectiveness over traditional ground patrols in applications such as security, surveillance, traffic monitoring, disaster response and remote terrain inspection. The authors compare conventional patrol methods with drone-enabled solutions, enumerate the benefits (e.g., wide-area accessibility, rapid deployment) and identify key challenges including energy/battery constraints, communication reliability, regulatory issues, swarm coordination and autonomy. Finally, the paper outlines future research directions to enhance drone patrol functionality, robustness and operational scalability, thereby providing a useful roadmap for scholars and practitioners in the field of aerial surveillance.

"GPS Systems Literature: Inaccuracy Factors and Effective Solutions" systematically reviews the core causes of GPS inaccuracy—categorizing them into three main groups: satellite signal issues, receiver-induced errors, and environmental influences—and evaluates various mitigation strategies proposed in existing research; by comparing techniques such as reference station networks, perceptive GPS (PGPS), map-matching algorithms, and especially Kalman Filter-based methods, the authors identify the Kalman Filter as the most effective approach, since it can correct multiple error sources (receiver/satellite clock errors, ionospheric and tropospheric delays, and multipath distortion), thereby offering a comprehensive solution for improving GPS accuracy in real-world applications.

"GSM Wireless Communication Sysem" provides a comprehensive overview of the Global System for Mobile Communications (GSM), outlining its architecture, system components, channel and frame structures, security features, and data services; it discusses the primary characteristics that made GSM a successful 2G technology, and also forecasts future developments by predicting the evolution of mobile networks into 4G, 5G, 6G, and 7G, highlighting how advancements such as massive MIMO, mmWave communication, and cognitive radios will support higher data rates, reliability, and ubiquitous connectivity in coming generations.

"A Literature Review on Determination of Quadrotor Unmanned Aerial Vehicles Propeller Thrust and Power Coefficients" reviews prior research on propeller performance for quadrotor UAVs, focusing specifically on the non- dimensional thrust coefficient (CT) and power coefficient (CP) which critically influence aerodynamic efficiency; it synthesizes findings from experimental (wind tunnel, PIV), numerical (CFD) and analytical (blade element momentum theory) studies, compares different turbulence models, rotor configurations, and interference effects between rotors, and identifies that while direct measurement methods offer high accuracy, CFD with an appropriate turbulence model is an efficient and cost-effective alternative, and emphasizes that the current literature shows a relative lack of studies on small-scale UAV propeller aerodynamics, suggesting future work should more deeply explore model validation and optimization under realistic multi-rotor interactions.

"Quadcopter: Design, Construction and Testing" presents a detailed methodology for designing, constructing, and testing a quadcopter UAV, covering the selection of frame structure, motor-propeller combinations, battery specifications, and electronic control systems; the authors carry out flight testing to validate the build and assess key performance metrics such as stability, lift, and maneuverability, and they also analyze vibration, thrust, and payload capacity to ensure that the quadcopter meets design objectives while maintaining safe, controlled operation under various load conditions.

"Literature Review on Drones Used in the Surveillance Field" provides a systematic literature review of unmanned aerial vehicles (UAVs) applied to surveillance in both indoor and outdoor environments, differentiating between heavier-than-air (HTA) systems (drones) and lighter-than-air (LTA) systems (blimps). The authors analyze advantages and challenges associated with both platforms — noting that while drones offer compact maneuverability and rapid response, they suffer from limited battery life and high energy demands, whereas blimps provide greater endurance, energy efficiency, and payload capacity due to their static lift. The study also explores navigation and localization methods, highlighting the use of GPS, inertial sensors, vision-based systems, and AprilT ags for indoor positioning, and discusses strategies for autonomy, object recognition, and energy management (e.g., battery swapping, solar power). The authors suggest that combining drones and blimps in a hybrid surveillance architecture could leverage the strengths of both systems to build a more robust, autonomous, and efficient surveillance solution.

III. PROBLEM IDENTIFICATION

Despite advancements in technology and growing awareness, women continue to face serious safety challenges in both public and private spaces. Incidents of harassment, assault, and violence often occur in locations where immediate help is unavailable or delayed. Traditional self-defense tools such as pepper sprays or alarms may not always be effective, especially when the victim is caught off guard or unable to react quickly. There is a pressing need for innovative solutions that can provide swift and automated responses in dangerous situations. The lack of accessible, real-time protective systems leaves a critical gap in personal security for women. Additionally, overcrowded public areas and poorly lit or isolated locations further increase vulnerability. Current law enforcement resources are often stretched thin, making it difficult to ensure timely intervention. A drone-based defense system equipped with non-lethal weapons such as a stun device and disabling gas can help bridge this gap. This approach aims to empower women with a reliable, technology- driven safety mechanism that responds instantly to threats. Identifying and addressing these gaps is crucial to developing a more responsive and effective personal safety solution.

IV. OBJECTIVES

- To prevent and mitigate harassment in public areas.
- To provide real-time surveillance and deterrence.
- To assist law enforcement in monitoring and responding to incidents.
- To enhance safety in high-risk environments.

V. METHODOLOGY

1. **An SOS signal is activated**

triggering an emergency response and automatically transmitting the user's location.

2. **The GSM module receives the alert**

establishing a communication link with the control system.

3. **The flight controller powers up**

initiating all essential drone systems and performing basic checks.

4. **The companion computer and ground station synchronize**

coordinating navigation, guidance, and mission control functions.

5. **Drone initialization is completed**

confirming that all systems are operational and ready for deployment.

6. **The drone begins obstacle detection**

scanning its flight path using onboard sensors.

7. **If an obstacle is detected**

the drone increases its altitude or reroutes to safely avoid the obstruction.

8. **If no obstacle is detected**

the drone proceeds along its designated path toward the target location.

9. **Upon reaching the target location**

the navigation phase is successfully completed.

10. **An appropriate emergency-response action is carried out**

such as delivering a first-aid kit, providing visual feedback, or sending a distress beacon.

VI BLOCK DIAGRAM

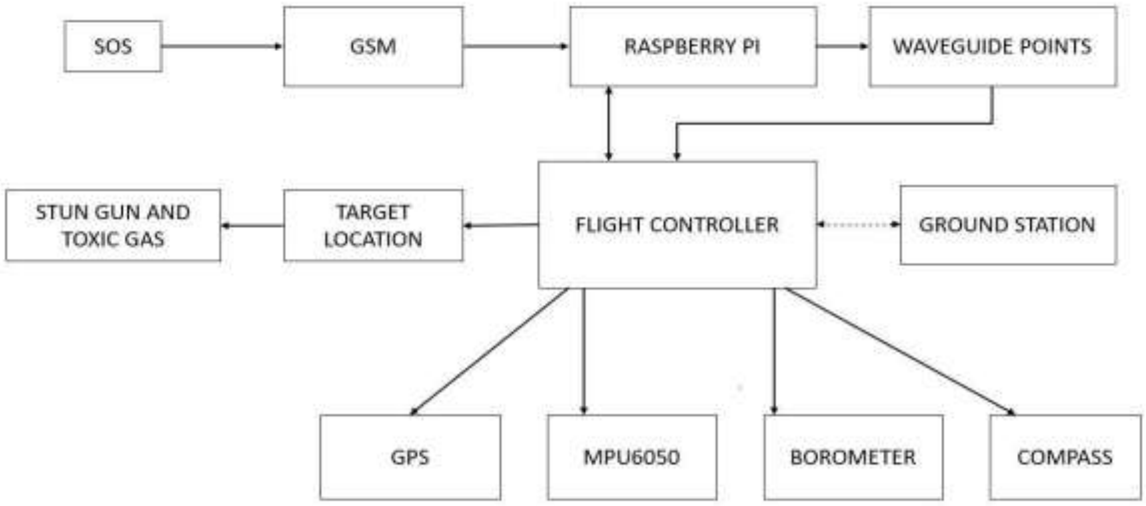

figure 1:block diagram of sky guardian :anti-harassment drone patrol

1. **Drone frame**

A drone frame is the main structural body of a drone. It is the part that holds all the components together, such as the motors, propellers, battery, flight controller, and sensors. The frame provides strength, stability, and shape to the drone. Drone frames are usually made from lightweight and strong materials like carbon fiber, plastic, or aluminum. The design of the frame (like quadcopter, hexacopter, etc.) affects how the drone flies, how stable it is, and how much weight it can carry

2. **SOS**

SOS is an international signal used to ask for help in emergencies. It is commonly used in distress situations such as accidents, danger, or when someone needs urgent rescue. In Morse code, It is easy to recognize and send, so it became the universal emergency signal.

3. **GSM (Global System for Mobile Communications)**

It is a widely used mobile network technology that allows people to make calls, send SMS messages, and use mobile data. It uses a SIM card to identify the user and works by connecting mobile phones to nearby cell towers. GSM is known for good voice quality, international roaming, and secure communication.

4. **Raspberry Pi**

It is a small, low-cost, credit-card-sized computer used for learning programming, electronics, and building projects. It works like a normal computer—you can connect a keyboard, mouse, and monitor to it. Raspberry Pi is popular for DIY projects such as robotics, home automation, IoT devices, and learning Python.

5. **Waveguide**

It is a hollow tube that helps carry high-frequency electromagnetic waves (like microwaves) from one place to another with low loss.

6. **Stun Gun**

A stun gun is a non-lethal self-defense device that delivers an electric shock to temporarily disable a person by disrupting muscle control.

7. **Toxic Gas**

Toxic gas is a harmful gas that can cause injury or health problems when inhaled. Examples include carbon monoxide and chlorine gas.

8. **flight controller**

It is the “brain” of a drone. It reads data from sensors (like gyroscope and accelerometer) and controls the motors to keep the drone stable and flying smoothly.

9. GPS(GlobalPositioningSystem)
Uses satellites to find your exact location, speed, and time anywhere on Earth.

10. MPU6050
A small sensor that measures **motion**. It has:
- **Accelerometer** → detects movement/tilt
- **Gyroscope** → detects rotation

Used in drones, robots, phones, and stabilizing systems.

11. Barometer
A sensor that measures air pressure.
It helps to estimate altitude (height) in drones, weather stations, and aircraft.

12. Compass
A sensor that detects the Earth's magnetic field and shows direction (North, South, East, West). Used in drones, mobiles, maps, and navigation systems.

VII. FLOW CHART

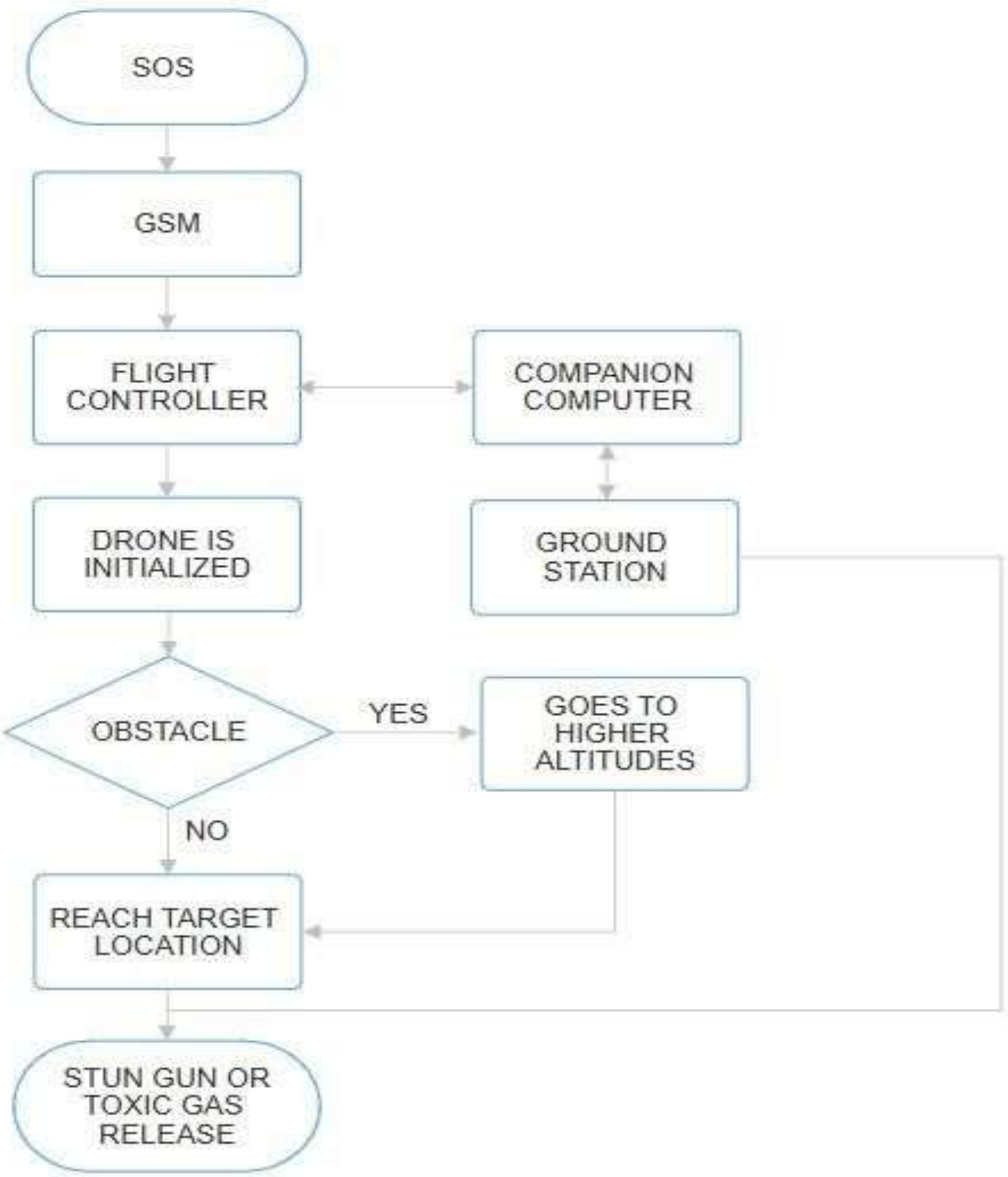

figure 2: flow chart of sky guardian: anti-harassment drone patrol

1. **SOS**
- The process begins when an SOS signal is triggered (for emergency/help request).
2. **GSM**
- A GSM module sends or receives communication signals (like location updates or a command to start the drone).
3. **Flight Controller**
- Controls drone movement.
- Receives instructions from GSM and the companion computer**.**
4. **Drone is Initialized**
- The flight controller starts all essential systems:
  - Motors
  - Sensors
  - Navigation systems
5. **Companion Computer**
- A powerful onboard computer that processes:
  - Images
  - Navigation algorithms
  - Communication with ground station
6. **Ground Station**
- A remote system (laptop/tablet) used to:
  - Monitor the drone
  - Send commands
  - Receive data
7. **Obstacle Check**
- The drone checks for obstacles using sensors (vision, ultrasonic, LiDAR). If an obstacle is detected:
- The drone increases altitude or takes a safer path. If no obstacle:
- It continues toward the target location.
8. **Reach Target Location**
- Drone successfully navigates to the desired point.
9. **Final Action (Safe Alternative)**

Instead of harmful actions, the drone can safely perform tasks like:
- Sending an emergency alert
- Capturing images or video for rescue
- Dropping a first-aid kit
- Delivering communication devices
- Sending GPS location to responders

VIII. APPLICATIONS

1. Personal Safety and Emergency Response: The system can serve as a rapid-response personal security tool, offering immediate protection for women facing threats in isolated or unsafe environments.
2. Smart City Surveillance: Integrated with smart city infrastructure, these drones can patrol high-risk areas and provide both deterrence and active defense capabilities, enhancing urban safety for women.
3. Law Enforcement Support: Police departments can deploy these drones to assist in rescue operations or to provide protection during high-risk situations involving female victims.
4. Campus and Institutional Security: Educational institutions and workplaces can use the drone system to safeguard women on campuses and in office complexes, especially during late hours.
5 .Public Transport Safety: The drone system can be programmed to monitor vulnerable zones like parking lots, bus stops, or train stations where women often face harassment or assault risks.
6.Disaster and Conflict Zones: In regions affected by conflict or natural disasters, where law enforcement presence is limited, these drones can offer women a means of self-protection and distress signaling.

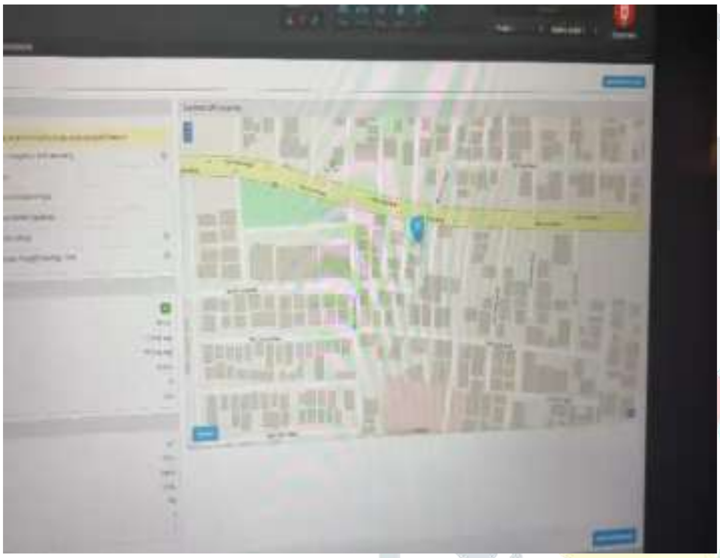

figure 4:GPS Location (INAV):

figure 3:drone setup

IX. FUTURE SCOPE

The future of women's safety technology holds promising advancements with the integration of drone- based defense systems. As personal security concerns rise, especially in urban and remote areas, such autonomous aerial systems could serve as immediate responders in times of danger. Future developments may enhance their intelligence through AI-powered threat detection, enabling the drone to autonomously assess risky situations and act accordingly. Integration with mobile apps and wearable devices can allow users to trigger the drone remotely in emergencies. With advancements in miniaturization and battery life, these drones may become more portable and accessible. Enhanced GPS and real-time tracking can improve response accuracy, ensuring help reaches victims faster. Furthermore, legal frameworks and safety protocols can evolve to regulate the use of non-lethal weapons like stun guns and disabling gases, ensuring ethical deployment. Over time, such systems could be adopted widely in public spaces, campuses, and transport hubs. The drone's surveillance capabilities can also aid law enforcement in identifying and preventing crimes. As technology matures, these systems could become a vital component of future smart safety infrastructure dedicated to protecting women.

X. CONCULSION

The development of a drone-based safety mechanism for women offers a proactive solution to the growing concern of personal security. By incorporating a stun gun and non-lethal gas, this system provides an effective means of self defense that can deter potential threats and offer immediate protection. The mobility and quick deployment capabilities of drones make them highly suitable for emergency scenarios, especially in areas with limited access to law enforcement. With advancements in automation, GPS tracking, and remote operation, such systems can be seamlessly integrated into existing safety infrastructure. Their application extends beyond individual protection to public safety monitoring and crime prevention. Moreover, as awareness and demand for women's safety technologies increase, these drones could become a common feature in urban security networks. The project highlights the potential of combining technology with personal safety tools to create a smarter and more secure environment for women. Continued innovation and regulatory support will be key to refining and deploying these systems effectively in real-world scenarios**.**

XI. ACKNOWLEDGEMENT

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