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## UAV SYSTEMS IN SUPPORT OF LAW ENFORCEMENT FORCES

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**Abstract:** *The world in which we live can often be dangerous. Then, law enforcement officials must use the best technologies to protect us, but many times they don't have the budget to buy such advanced equipment. The UAV is the best airborne platform for surveying areas in which unpleasant things might occur. Instead of using an expensive helicopter or airplane, or sending human beings into a potentially dangerous situation, you can use a UAV platform to capture video evidence you need. Due to its silent flight and small dimensions, compared with a normal aircraft, UAV won't disturb the scene being surveyed. Having video, low light or FLIR cameras on board, you get the picture that your organization need, without exposing your people. The expenses are also at a fraction level from those inferred by a conventional manned aircraft mission. The response plan of the street cops in uniform to a call is based on their experience and information acquired from various sources and on scene observations. In such situations they may benefit also from the live images obtained with the help of a non-expensive eye in the sky. Strategies and decisions based on accurate information in hostage taking act or barricaded subject can save lives and prevents injuries. With a UAV help you may have a big picture instead of visual limited recording from the ground level. Also, once the event and activities are recorded, you have valuable information available for review as evidence or as an authentic training tool.*

**Key words:** *UAV, support, law enforcement, scene observations, cop missions*

### 1. INTRODUCTION

When they are dealing with a dangerous situation, police officers are needed more information before get involved. In this way the operation of the planned intervention will be more responsible planned, more efficient and less risky. Normally this information is gathered by police on the spot. These policemen are exposed to dangers in the environment in which they operate. To avoid this situation, if conditions permit, one may use the support aircraft and helicopters. Usually, large organizations have such means but they are available in limited numbers and require qualified pilots to high operating costs. Under these conditions UAVs may be an alternative to conduct surveillance and reconnaissance activities.

Easy to transport to the venue of the operation they can perform aerial survey of the area using a video camera or thermal imager. UAV enables the police to see the roof or behind buildings regardless of surface configuration. They can also be maintained for a long time over an area to help the command and control mission.

UAVs can carry sensors to detect dangerous chemicals or drugs; may monitor areas inaccessible for extended periods.

Operating costs are much lower compared with those of helicopters; their use is much more advantageous for the support of smaller formations of police.

### 2. POSSIBLE MISSIONS

UAVs may be used as a means of support, with unique potential for a wide range of

missions from the police portfolio. Its ability to provide a "view from above", from multiple angles of a fixed or a moving target provides the opportunity to supply a larger amount of information that allow a more accurate analysis of a operational situation and take the most appropriate decisions to resolve.

We will examine tasks that could be successfully achieved in these devices.

## 2.1 Patrol neighborhoods

Persistent presence of a UAV over a densely populated suburbs may reduce crime. Patrol will be most effective if they will fly both day and night, so avoiding the usual routes and flight after pre-flight programs. The observation of a target from the air at altitudes of  $150 \div 250$  m at a speed of 100 km / h, allows a 10 times greater visibility than a land patrols.

Street crime, looting, robberies, car thefts, etc. may be detected directly from the air. Based on information received may be made a intervention plan of the ground forces. Reduction in crime makes cities safer living environments for residents and gives them back their confidence in widely accepted social values.

UAV capability to maintain for a long time over targets allows coordination of the intervention forces and warning of the dangers that threaten them. In this way reduced the risks police team members are subjected carrying out missions.

In addition to the helicopters, UAVs can fly without being detected by ground. Also there is no risk of serious injury or death to crew members, given the low-altitude flight in an area with high density of obstacles on the ground.



Fig 1 – UAV VTOL for survey

**Purpose:** Detecting criminal activities and stop them.

**Objectives:**

- Protection of the integrity and life of citizens.
- Protection of property.

**Methods:**

- continuous shooting by day and night, in low visibility conditions;
- infrared film;
- high resolution pictures.

**Activities monitored:**

- theft;
- robberies;
- murder;
- taking of hostages;
- prostitution;
- road accidents;
- car chase escaping control;
- disturbing public;
- trafficking in drugs and other banned substances;
- trafficking;
- illegal commercial activities.

**Land Characteristics:** "urban 3D relief" is composed of buildings and streets. The cities are blocks with heights ranging between  $10 \div 25$  m on the roof of which are GSM antennas increasing the overall height of 30 m. The small green spaces around the blocks are planted with flowers and shrubs to 3 m high. The rest of the spaces are arranged as parking.

Access roads have widths ranging from 2 m in the historic centers of cities up to 20 m on the boulevards. On their side are rows of trees and lighting columns 5 to 10 m high. Above



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the streets are suspended overhead wires to power electric vehicles for urban transport (4 m height). There may well be large parks with lawns dotted with works of art, with lanes 2 to 3 m wide and flanked by ornamental trees with heights between 1.5 ÷ 5 m or clumps of forest with trees of above 7 m.

In some areas are central markets where can be organize demonstrations and other cultural events.

On the main roads traffic is high, decreasing on the access streets in residential areas and became fragmented on alleys between blocks. In smaller towns the traffic is lower except the transit routes of national or international routes.

Cities are located on flat surfaces or on a range of hills or on the slopes of a mountain. Cities on the plain are built with spaces between buildings, wide streets with large parks. The old cities are crowded with narrow and winding streets. Cities on the mountain are built on inclined slopes with buildings stuck together, with open space close to zero, with narrow and winding streets, that have a height slope.

At the outskirts are industrial zones with halls between 5 to 7 m high and access roads for transporting goods. The halls are surrounded by large surface areas for vehicle parking and storage of goods.

**Climate / weather:** urban settlements are scattered throughout the area of the country so that we meet the entire range of temperatures (-35 ÷ 45<sup>0</sup>C) and weather. The lowland areas are subjected to persistent winds (15 ÷ 35 km / h), the storms (over 70 km / h) or tornadoes, which fell trees and tear roofs bring or down the power grid. In the winter blizzards are affected them, sometimes leading to blocking traffic. Rain, heavy at times (25 ÷ 45 l/m<sup>2</sup>), may even lead to stopping the traffic by

flooding the streets. In the summer fall torrential rains with lightning and hail.

In general the blocks reduce the wind speed but produce swirls in their neighborhood. Large asphalt surfaces and facades of buildings radiate heat so the temperature is a few degrees higher in summer within localities, may exceed 40<sup>0</sup>C.

### Scenarios

Scenario 1 - A small UAV platform will be launched by members of a patrol. It recovered in the locations that will not endanger the integrity of others, making the operation with its own resources, without special arrangements. Air vehicle will travel on a pre-flight path, surveying from air urban area of 1x1 km. He will fly to a height between 250 ÷ 300 m. To capture the details will be lowered to a height of 100 m. He will transmit images in real time to the ground patrol, around the buildings, on the streets, within parks. If suspicious activity is detected they are located and the vehicle will float above, supervising permanently those involved. If they move to a motor vehicle will be pursued by the UAV. Based on information received from the air patrol will decide where and when intervention and may ask for support if necessary.

Scenario 2 - An UAV Platform launched from a mobile unit will fly at heights of 500 ÷ 800 m with speeds of 80 to 100 km / h on a path of "combing" surveying strips of 6x6 km. To capture the details will fall to 300 m. The images are transmitted to a command center. . Recovery will take place in an area on the outskirts, with their own means, on undeveloped land. Upon detection of suspicious activity, these will be located and land patrols will be moved to those areas. Until the arrival of ground units UAV will run hovering over the target or will follow ground moving target. Upon arrival directly to the

patrol will provide tactical information. After that they will resume patrolling the predetermined trajectory.

Scenario 3 - A UAV platform launched from a mobile unit will patrol an area up to 10x10 km at heights of 800 ÷ 1000 m on a stationary trajectory. It will transmit images to a command center along with other sensors on the ground. When suspicious activity is reported, an operator in the center will move the platform to the area indicated. If you need to be lowered to a height of 300 m. UAV will perform hovering over the area by providing basic information to evaluate the situation and prepare intervention scenario. The arrival of ground patrols, will resume its patrolling on the old path. If you have followed a suspicious car and locate the UAV will be followed throughout its route allowing permanent location. If it is a car moving at high speed to avoid being stopped by officers on the ground it will be followed by surveillance UAV, thus being able to block intersections so as not to cause serious accidents. UAVs can also accompany an ambulance carrying a serious case to allow land units clear the traffic. Such a UAV could transmit control centers about traffic jams, traffic flows that can be leverage for intersections directing or diverting traffic detours.

## 2.2. Traffic monitoring

Traffic monitoring is currently a chain of terrestrial sensors scattered along a road. Each sensor has the ability to monitor a small portion of the road transmitting images to a traffic monitoring center. Analysis of information received from a relatively large number of such fixed sensors allows creation of an image on the traffic density (number of vehicles per km), the main flow direction of their movement and detection areas which such streams disruption occurred. In general the result is a big error margin is achieved after a long time to process raw data. Most times it is necessary to gather additional information by a ground observer moving in a given area. Rapidity of its movement will be slowed by traffic jams so that an assessment of the situation will be much slower, response

time will be much higher, the situation will get worse and the chances of survival of victims of road accidents will diminish considerably .

If the same information would be taken from a UAV moving at a sufficient height and with a higher speed than the vehicles on the road, it would allow real-time visualization of a much longer road sections, conclusions can be drawn immediately by a ground observer who can instantly assess the situation and prepare a intervention plan that would lead to speedy resolution of the situation. If road events occur they can be quickly located and evaluated given the short time the UAV can reach the place of their occurrence, because he flies in a straight line, the shortest path, unimpeded by obstacles and speed. Moving terrestrial means to rescue victims from accidents can be directed to detours, less crowded, that response time be as short as possible.

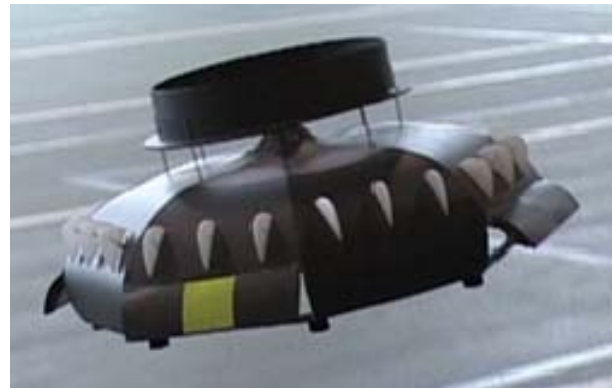


Fig 2 - UAV VTOL for traffic monitoring

### **Purpose:**

- Ease traffic.
- Increase traffic safety.
- Saving the life of people involved in accidents.

### **Objectives:**

- Establish traffic flows in order to fluidize them.
- Detection and removal of traffic jams.
- Finding and identifying those who violate road regulations.
- Location of the accident and obtain information quickly, immediately after production.
- Research site accidents.



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- Monitoring land vehicles transporting accident victims to hospital, to clear the route.

**Methods:**

- continuous shooting by day and night, in low visibility conditions;
- infrared film;
- high resolution pictures;
- travel speed measurement radar method;

**Activities monitored:**

- violating rules of conduct road;
- production of road traffic accidents;
- roadblocks;
- heavy traffic;
- identification of traffic flows.

**Land Characteristics :** Roads crossing plains and plateaus, follow the thread of water, the winding hills or mountains, crossing water courses or precipice. They are built at elevations ranging from sea level to over 1 km.

Roads cross grassy plains or fields planted with crops, wooded areas, or goals alpine, following rock slopes or strain on the bottom of deep valleys. They are often flanked by rows of trees (3 to 6 m).

**Climate / weather:** roads. cover the whole country so that they meet along the whole temperature range (-35 ÷ 450 C) and weather. The lowland areas are subjected to persistent winds, the storms and tornadoes. In the winter blizzards are blocked. Throughout their fall precipitation, sometimes heavy rainfall can lead to stopping the circulation. Summer torrential rains occurring with lightning and hail.

**Scenarios**

Scenario 1 - A UAV platform will run patrols consisting of surveillance of a portion of road 100 km in length. The launch will made from mobile units on the ground and the recovery by its own means, on undeveloped

land. Air vehicle will travel at speeds 80 to 100 km / h, following the path of the road and slightly to one side of it. Video images will be transmitted to mobile crews or to route traffic monitoring center. Simultaneously, it may record the vehicle speed along with recognition of the speeding vehicle on the section of road monitored. Upon detection traffic jams will be located, and UAV execute hovering above the busy intersection providing data to the ground crew by on vehicle flows on emerging directions. Upon detection of a traffic accident, the air vehicle will fly for collecting information about vehicles involved, the losses recorded, the status of the persons involved. Based on these images will be able to analyze the production of accident and the guilt of those involved. When transporting the injured persons to the nearest health facility, the ambulance will be tracked from air, in order to remove bottlenecks on the route.

Scenario 2 - small UAV platforms will be launched by members of mobile patrols in the hand. They will act at a distance of 1 ÷ 2 km from the launch site. They will provide patrol video witch will intervene to punish drivers out of traffic and unruly. When blocking an intersection, the ground crew in charge of directing circulation will receive information about the directions that recorded the main streams of traffic and queue length on each direction beginning at the intersection. If traveling to a traffic accident on a road blocked traffic the mobile crew will gather the first in formations by sending an UAV. The investigation at the crash site from the ground crew will be able to analyze aerial filming production to determine how the accident, location and fixation of trace evidence for their submission to court.

### 2.3. State Border Patrol

The need to secure the frontiers demands new technologies to strengthen the capacity of border guards to prevent, detect and apprehend smugglers, terrorists and those attempting to illegally cross the border.

UAV is the "eye in the sky" which was lacking until now. This new technology will complement the presence detection and information gathering systems, now existing, and will work integrated with them.

Video images from the UAV will be transmitted in real time to ground patrols.

UAVs will be even more effective in remote border areas, where access is difficult and staff safety is jeopardized while the infrastructure is difficult or impossible to build.

Also simultaneous transmission of information in a unique coordination center will lead to increased mobility of ground patrols.

Interception and retention of groups of illegal immigrants eliminates the economic crimes they might commit in the country as: trafficking in drugs, weapons, living beings, undeclared work.

Confiscation of illegal transportation of goods leads to increased revenue from the state budget.

Terrorist groups can be stopped at the border as being defended people's lives.

Decrease or even eradicate drug trafficking and other hallucinogenic substances leads to maintaining the health of the population and reducing mortality.

Preventing leakage outside the country of strategic metals lead to enhancement of defense, sovereignty and national independence.

Interception of traffic with works of art has the effect of strengthening the people's national identity.



Fig 3 - Combine UAV-UAS for border patrol

#### **Purpose:**

- Detecting and stopping criminal activities taking place on the border - both in the border strip and a certain depth within the national territory (30 km).

#### **Objectives:**

- To protect life.
- Protection of national economy.

#### **Methods:**

- continuous shooting by day and night, in low visibility conditions;
- infrared film;
- high-resolution photos.

#### **Criminal activities:**

- Smuggling weapons, drugs, counterfeit goods, stolen goods;
- illegal border crossing;
- trafficking.

**Land Characteristics:** The land border crosses most diverse landforms: alluvial flat or steep cliffs, vast plains or slightly wavy, more or less hilly terrain, steep mountain walls, cut by deep valleys.

The meadow area is spread over large pieces hardwood forests relatively of tall trees (3 ÷ 8m). Along the shores are formed, in the dry season, small beaches (5 to 30m).

Vegetation in the plateau region is composed of steppe grasses interspersed with small shrubs (0.5 ÷ 2 m) and isolated trees. Rarely encountered of small groups of forest formed from relatively high trees (2 to 4m).

The vast mountain areas are covered by dense forests of tall trees (6 ÷ 8m), interrupted



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by small grassy and dense meadows. Alpine areas are covered by dense vegetation of dwarf shrubs (0.3 ÷ 1 m) or tangled grass (0.1 ÷ 0.3 m) was strewn with boulders and of small rocks (0.2 ÷ 0.5 m) .

**Climate / weather:** Conditions will be depending on the area. The mediteranian influenced climate in SE, the harsh climate in the mountain areas of N. Since the prevailing winds of moderate intensity (15 ÷ 25 km / h) in areas with persistent, cold and violent winds (40 ÷ 80 km / h ) which occur in winter storms. Annual precipitation is in the form of rain and snow, which can be quiet or as heavy falls (25 ÷ 50 l/m<sup>2</sup>). In the summer heavy rainfall is accompanied by lightning and hail. Sometimes summer design storm and even tornadoes. Lows down to -10 °C in the SE while the mountains to -25 ÷ 30 °C. Summer temperatures are recorded the 30 ÷ 35 °C in S and E.

### Scenarios

Scenario 1 - UAV platform will run patrols consisting of surveillance of areas in the form of strips of 10x100 km. The launch will be on patrol vehicles fitted with catapults and recovery will be done by landing UAV, using of it himself, in undeveloped areas. The flight will be performed at altitudes ranging between 600 ÷ 1500 m above the ground. The flight path will be set up so that it can be under surveillance as long a time a certain area of land. Platform for identifying people and vehicles will come down to 500 m. In the data transmission distances beyond LOS (Line of Site) the ground relay networks is a useful presence, that can also provide command and control of UAVs. Data is transmitted to a regional command center and the ground mobile units. Command Center will conduct mobile crews.

Scenario 2 - small UAV platforms will be launched from the hand by mobile patrol units. They will do reconnaissance on a radius of up to 4 miles around the patrol. The platforms will rise to a height of 300 ÷ 500 m above the ground from where they will transmit images in real time to the patrol commander. When illegal activities where detected they will float above the ground providing tactical information. Recovery will be done in-house, in undeveloped areas.

Scenario 3 - UAV platforms will make the standby flight over a territory. During this time they will do air-to a 10x60 km area. At the onset of the presence detection sensors placed on the ground they will automatically be routed over the territory from intruders raped running research area by "combing", the detection and identification of beings from the ground. After execution of the mission will resume patrolling the old area or will be moved to another area. Images will be transmitted at the regional command center and during the intervention patrol commander, too. During the intervention UAV's command may be entrusted to chief patrol. In this case it is necessary that terrestrial communications network to transmit data and to exercise UAV's command and control. The platform will provide real-time image.

### 2.4 Actions special intervention forces (SWAT)

Live of the fighters in the special forces are submitted at risk during each intervention. To avoid threats that are lurking behind a grove of trees, a wall or a building, the solution is the observation from the air, from an aerial platform, which provides so-called "view over the hill. "

Helicopters should be lifted in the air with a certain time before the onset of the operation

due to preparations for the flight duration and can be easily detected due to noise and large size. Instead UAV can be launched immediately on the ground, operating undercover, and in addition, much lower cost.

After a reconnaissance made before the mission beginning, topography will be much better known, so that intervention will be more accurate planning, eliminating many of the risks. Air surveillance of the action enables information the team members about the dangers that occur over time.

Using UAVs reduce hazards for members of SWAT troops and provide a high degree of success of the missions.

**Purpose:** Gathering of tactical information.

**Objectives:**

- Stop the criminal activities.
- Protect life.

**Methods:**

- continuous shooting by day and night, in low visibility conditions;
- infrared film;
- high resolution pictures.

**Activities monitored:**

- theft;
- taking of hostages;
- trafficking of arms and explosives;
- terrorism;
- trafficking in drugs and other banned substances;
- trafficking;
- illegal commercial activities.

**Land Characteristics.** The action mostly takes place inside buildings or inside some isolated farms. Sometimes monitored activity occurs on the roof of a tall building (30 m). Sometimes it can take place in a suburb with luxury properties surrounded by high fences that do not allow for the courtyard.

Illegal activities can take place in port, on a boat. Sometimes the ship is moored, sometimes is roadstead.

Terrorist threats can occur offshore platforms located at sea (60 ÷ 200 nm).

Goods or hostages may be carried in motor vehicles traveling on roads or rough terrain.

**Climate / weather:** The objectives can be located anywhere within the country, so that at the time of intervention can meet the full range

of climatic and weather conditions specific to our country.

### Scenarios

Scenario 1 - A very small UAV platforms launched by special forces rises along the walls of tall buildings spying through the windows. They remain in homes hovering at the window where they detected suspicious activity or fixes of walls where it transmit real time images and sound on the ground. Launch is made from hand and recovery in the same way.

Scenario 2 - small UAV platforms are launched by hand by the intervention units. They fly over the target at heights between 150 ÷ 200 m and can fall to 50 m. They will fly over the target on stationary trajectories collecting information about the topography, the presence of people and activities. They will be maintained above the target after penetration of the intervention teams providing tactical information. Recovery is taking place in areas where there aren't endangered others.

Scenario 3 - UAV platforms are launched from land or sea mobile units. They are moving at high speed (150 ÷ 200 km / h) over a target where it made hovering at heights of 300 ÷ 500 m above the ground, gathering information about goals and activities and sending them to intervention team. At the start of operations will provide tactical information. On completion of the operation will be recovered by landing unprepared zones or recovered with special means on ships.

## 3. CONCLUSIONS

1. Small UAVs are a vehicle of aerial surveillance as effective as conventional piloted aircraft. They can be used to support the mission of maintaining public order throughout the national territory.

2. For the police, UAVs are required to perform work surveillance, reconnaissance, information gathering and tracking fixed and mobile targets, which are essential components in the performance of specific tasks aimed at protection of life and property.

2. When choosing from the diversity of existing UAVs, the best for police needs are





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those that can be easily transported in mobile units and do not require ground facilities for launch and recovery.

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