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Infrastructure System For The Future's Flying Vehicles

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ABSTRACT: *İn this study, infrastructure analysis was carried out within a system integrity of all objects that will fly in accordance with the civil aviation rules in the world atmosphere. It has been tried to determine that for all vehicles flying in the Earth's atmosphere how safe they will use the atmospheric void when objects fly in real time, how to safely fly and to determine flight paths. A system has been worked on for all manned and unmanned objects, such as flying automobiles, buses, trains, balloons, drones and the like, which are now partly used in civil aviation but may be real in the future. A proposal has also been made for the solution of possible future aviation problems. Among them, classified as manned air vehicles and unmanned aerial vehicles. In addition to this, the necessary technical specifications which have to be necessary for the vehicles have been determined. Furthermore, safety and support systems have been established to manage air traffic safely. In short, the virtual city was established in the air.*
KEY WORDS: *Drones, flying vehicles, aircraft, air traffic management, virtual air city.*

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I. INTRODUCTION

As flying vehicles or flying objects, many studies and researches have been done in recent years, apart from classical aircraft. Although these aerial vehicles have different names, they all use the Earth atmosphere. For this reason, flying objects are classified as follows. These;

a. All living creatures, big and small, flying in nature,
b. As all flying objects made by humans

We think that it would be a correct classification to describe. All kinds of flying creatures that exist in nature, do not need anything like communication and management. While they are created, Allah has created perfect with all necessary equipment. For these creatures, humans have not enough information and technological accumulation to make an additional system to be added. Moreover, human beings are neither skillful nor knowledgeable enough to manage these creatures. On the other hand, these creatures also have no need for special governance. For this reason, this part is beyond the interest of flying object technology that humans want to develop.

The subject of the administration of flying vehicles is all the things that man himself has done. Some of these objects use the air, some on the land, and some use the sea environment. In the future, there will be vehicles to be used in the air, on land and at sea. However, the area that is still unavailable is the underground and the ground. The most prominent example of this is that the habitat of the mole and worms uses underground soil by opening roads under the ground. If mankind develops such a technology in the future, we expect to develop systems that make their own way and prepare their own living environment.

Aircrafts are the most known flying objects. These aircrafts can be classified generally as, passenger carrying aircraft, the aircraft used by security forces and police officers, briefly the security forces and helicopters. Other flying objects may be classified as missiles and new generation spacecrafts, which can be used repeatedly for military purposes, and rockets or carriers that are used in space operations. We also think that it would be appropriate to consider manned space vehicles as a separate class. These are different types for different purposes. These are space vehicles that use the Earth's atmosphere and space together.

The other type of aircraft is balloons. Balloons are air vehicles produced according to flying vehicle design techniques. They are designed and manufactured in different shapes according to the purpose. These systems are still used for various purposes even if they are not used very often. Maybe it can be used to build aerial space cities with new developments in balloons over the next century.

There are many researches about flying vehicles. These studies are carried out by many countries and companies in a partly open and confidential manner. For this reason, the size of the total budgets in the world is not known precisely. However, it is estimated that large amounts of money have been spent for the research and developments.

Drones and their different types, as next generation flying vehicles, can be suitably different for the purpose of users [1-7]. For this reason, drones are now more prominent in this area. The main reason for this is the unmanned and inexpensive cost that is used by many individuals and institutions for a variety of purposes [8-16]. They are used as an effective weapon in war [8-11,17,18]. Drones can be used in a wide variety of jobs by protecting the borders of the country [10-11], neutralizing terrorists [11], automation in agriculture [14] and in the future, it will be developed in unpredictable ways and used in many different jobs . It is also possible to develop the drones as manned and unmanned. For this reason, the establishment of an international common legal system in the future will become mandatory [15,19]. There are other arguments for different uses of drones [20].

Besides security, drones are used as a pioneer in mail transport and unmanned package distribution. In Turkey, they are widely used for Coast Guard Protection, security purposes in beaches, rescue surveillance, security surveillance, transportation of emergency rescue materials to endangered people, traffic police road inspections and open air mass rallies, and for the protection of large human communities. Apart from these, they are also used by smugglers and terrorists.

The economic size of the Drones in the world and their use in projects has exceeded $ 127 million dollars. (White Cooper house-research-2017 10-august-media NTV) [21]. While states and institutions legally use drones, recently, they are used illegally by terrorist organizations. In this case, we think that it is not wrong to call terror reorganization and technological terrorist as new kinds of terror resources. We think that the use of drones for a variety of purposes can be used in areas that are unpredictable today because they are easy to obtain, unmanned and cheap.

II. DETERMINATION OF THE ROADS OF THE FLYING VEHICLES

Two classes are made to determine the paths of air vehicles flying in the Earth's atmosphere. These are;

A. Human Carrying Air Vehicles:

1. Intercontinental commercial supersonic air vehicles,
2. Intercontinental passenger aircrafts,
3. Domestic passenger aircrafts,
4. Human-Bearing Balloons,
5. Commercial taxi helicopters,
6. Flying commercial taxi, passenger bus, train etc.
7. Manned Drones,
8. Manned Quatrokopters,
9. Air Police and Military Helicopters,
10. Other manned aircrafts.

B. Unmanned Aerial Vehicles:

1. Unmanned drones,
2. Unmanned commercial drones for cargo transportation,
3. Balloons,
3. The other air vehicles used by amateurs.

The priority here is to determine flight paths at high altitudes from other unmanned aerial vehicles so that manned vehicles can fly safely. The reason for this is that we estimate that the number of unmanned aerial vehicles will be much higher than the number of manned aircraft. Furthermore, the technological and security support system of manned aircraft must be more qualified than other unmanned aerial vehicles

If unmanned aerial vehicles are to be visually inspected, they must be of a limited height. Also, they must not fly on flight routes. If these vehicles have the necessary flight equipment, they can use safe airways reserved for them. However, in order to fly safely, there must also be a height and spacing that is safe enough not to be affected by the air turbulence of other aircrafts. For this reason, there can be three types of air traffic. These;

1. Side by side roads
2. Overlapping-over-the-top roads,
3. Roads that can be used side by side and bottom-up.

The use of these roads may be necessary according to the geographical conditions of the flying aircraft. However, flights in free space may be at elevated heights without meteorological events on Earth's atmosphere. The planning of flight paths can be very limited for the environments outside of this, especially due to irregular building heights in major cities, unevenness of zoning plans, and the fact that city plans are made for land, not for new situations. These include:

1. Free flight routes,
2. Compulsory flight routes and,
3. Limited free flight routes.

Air vehicles using these routes can be used depending on where and how they fly. Flight can be used over time in these three ways because of the change of geographical region, the change of altitude.

1. Free Flight Routes:
The use of these routes is more likely to be within the Earth's atmosphere, for certain high altitudes for air vehicles such as high-flying passenger aircraft. For free space outside the world atmosphere is currently invalid. In free space, it is possible to fly in the desired manner for the time being. Because the existence of other celestial bodies is more important than the air vehicles in free space. Free flight areas can also be restricted in major city centers. This can have different causes. The first thing that comes to mind is the very private buildings, military and security centers and also, strategic industrial zones. Free flights in these areas may be particularly detrimental to unmanned aerial vehicles. Free flight routes can be used for any kind of aircraft outside the residential areas. In particular, the intercity may be more appropriate for distances of a certain kilometer length. The basic measure here is that it depends on residential areas and the density of the air traffic.

2. Compulsory Flight Routes:
Compulsory flight routes are the method applied in today's civil aviation. This can be particularly restricted to flights in strategic areas of unmanned aerial vehicles carrying combustible, flammable, explosive-like loads within aircraft. Another type of Air vehicles is flying automobiles. The reason for this is the possible loss of life and property. Especially, it is a precaution taken to minimize the accidents that may be caused due to the construction of the building heights in inappropriate architecture and to protect the safety of life and property. The other reason should be to ensure that they will be able to use the roads they are likely to land in the event of a breakdown in a possible air car. For this reason, the way they use land vehicles, the use of manned air vehicles like the ones going in the air, is suitable for planning the current city.

3**. Limited Free Flight Routes:**
The meaning of limited free flights defines the routes that air vehicles will use. Air vehicles that use these routes depend on where and how they fly. If residential areas are spread over very large areas and there are very few building constructions and especially if the buildings are composed of buildings such as two floors and three floors, limited free flights can be made in these areas.
It is better to fly all types of aircraft, especially those outside of the residential areas excluding the passenger aircraft, above the residential areas with high population density after having experience with human beings. The reason for this is the emergence of problems that can not be predicted today.

Figure. 1 is defined as an representative route for safe flight.

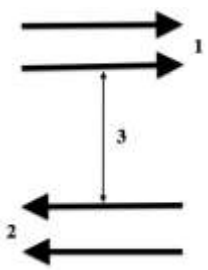

Figure 1. Air traffic: 1. Going, 2. Returning and 3. safe distance between two lanes. (Height for safe flight, horizontal gap and safety lane in emergency situations).

This gap in Figure 1 is left to be used for emergency situations. In Figure 2, the road is the horizontal road type. The other figure 3 is the type of parallel road with altitude difference. In this case, security gaps can be left both on the right and on the left. The conditions for releasing these intervals should be left to account for the turbulence effect of the aircraft.

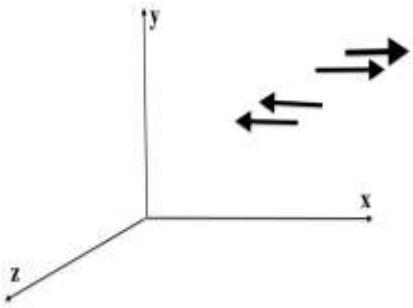

Figure. 2 Side-by-side parallel traffic flow

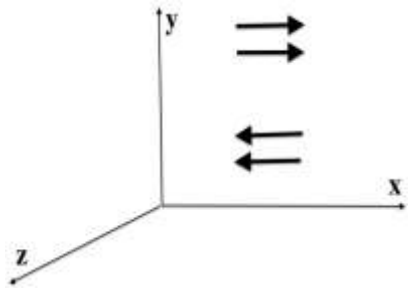

Figure. 3. Traffic flow with bottom-up technique.

Possible safety issues in flying vehicles:
These :
a. Problems caused by the vehicle,
b. Problems arising from the flight area,
c. They are problems caused by weather conditions.

The reason for these problems is that the aircraft is physically small, the aerodynamic structure, the problems caused by the design conditions, the effect of other vehicles on the air turbulence, the effect on meteorological conditions. These vehicles should not be affected by Meteorological events and conditions such as wind (up to certain values), rain, cloud, fog, lightning, hail and snow. In particular, manned flying vehicles must be stable to some extent for meteorological conditions . The physical size of the flying object, the small size of the flying object can always pose a problem and risk for other vehicles originating from the traffic density in the flight area.

Another practical solution for flights of aircraft is to provide free flights. So it's just to set the height and release the air routes. This is a reasonable solution for low density areas in the air traffic. But it can not be reasonable within dense residential areas. The reason for this is the legal gaps created by mortal and material loss accidents caused by the fall of air vehicles. As a result of the accident caused by the fall of the aircraft, the insurance companies meet the mortal, material and other indemnities. For these events, the international similar regulations and the countries have similar domestic law regulations. However, there are currently no legal regulations for licensed and unlicensed Drones and other aircrafts.

How do you insure drones with a financial value for $ 100 dollars? Which measures should be taken in relation to the prevention of human death, injury and financial losses caused by them? Is the prohibition of flights on sensitive industrial zones a solution? For this, legal arrangements must be made for the absolute solution of these problems.

III. SAFE INFRASTRUCTURE HARDWARE AND SETTLEMENT REGULATION FOR FLIGHT OBJECTS

There must be some compulsory electronic systems for safe flight in flying vehicles. These are:

1. For human air vehicles, compulsory electronic systems,
2. For unmanned aerial vehicles, compulsory electronic systems,
3. For flight safety, the qualifications of these mandatory systems must be well defined. If it is needed, it should be done with the legal regulations.

These also require the provision of minimum flight equipment for unmanned vehicles carrying primarily human-owned vehicles, vehicles carrying commercial cargo, and cargo-carrying vehicles at distances beyond sight. These systems may vary according to the conditions of the day and the new flight arrangements, and new arrangements should be made. These should be navigation, GPS, altimeter, communication systems, short distance vision system (minimum 1km), medium distance vision system (minimum 5km) and long distance vision system (minimum 10km). Apart from these, the general traffic system should also be a real-time system. For the unmanned aerial vehicles, autonomous (autonomous) systems, semi-autonomous systems, compulsory necessary infrastructure for intelligent fully autonomous systems must also be defined in advance. The production of all flying vehicles must be determined according to the technical specifications of the flight routes and classified according to the technical specifications of the flight certificate. However, the availability of these systems also means more weight, more cost and consuming more power for the aircraft.

Figure 4 shows the recommended height regulation for licensed flying vehicles and other infra-structures.

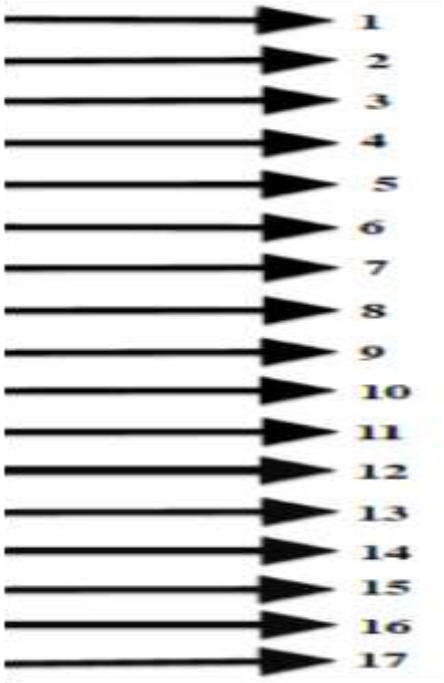

Fig. 4 Recommended structure and path sequence for licensed flying aircraft. (from top to down arrangement)

A. Electronic Management Systems:

1. Satellite for close-range communication purposes,
2. Close-range GPS satellites,
3. Close-range navigation satellites,
4. Radar satellites,
5. Communication systems and balloon base stations
6. Balloon Base stations: Real-time air internet network system,

a. Air section (the section to be used when the car is in the air)
b. Ground section (section to be used when the vehicle is on the ground)

B. Settlement Plan for Manned Aircraft:
7. Inter-continental commercial supersonic air vehicles,
8. Intercontinental passenger aircraft,
9. Domestic passenger aircraft,
10. Security Road (Police and Military vehicles),
11. Commercial Taxi and Helicopter,
12. Flying commercial coaches and trains
13. Manned Drones
14. Manned Balloons

C. Order of Settlement for Unmanned Aerial Vehicles:
15. Unmanned commercial aircraft for cargo transportation (Drone etc.).
16. Unmanned drones,
17. Amateur other aircrafts.

IV. FLIGHT VEHICLE MANAGEMENT SYSTEM

There must be very different systems to be used in flying vehicles. These include RADAR, LIDAR and acoustic radar systems. Optical camera systems for close range views and telescope camera systems for long distance can be used. The selection of the signals of these systems, their discrimination from other signals, the separation of interferences, the prevention of scattering, the ineffectiveness of scattering to receivers, the determination of direction of incoming signals and the distinction of proximity / distinction of incoming signals are very important problems. For optical signals, it should be minimally affected by weather conditions such as cleaning the optical light pollution, atmospheric lightning, lightning strike, thunder, wind, snow, rain, hail, cloud and fog. If these systems are affected by atmospheric events, safe flights can only take place in open and calm weather. This means that there can be very few geographical places all over the world with open weather conditions. For this reason, all flight systems should be equipped with electronic systems that are not affected by the atmospheric conditions, are compatible with the weather conditions and are geared to weather conditions. The heights of the satellites in this infrastructure system can be between 100Km-5000Km depending on the geographical area of the country on national basis and between 10.000Km-20.000Km internationally.

The basic parts of the management system are;
1. Low-altitude communication satellites,
2. Low-altitude GPS satellites,
3. Low altitude navigation satellites,
4. Radar satellites,
5. Balloon fixed base stations
6. Real-time AIR internet network system,
a. Air section (the section to be used when the car is in the air)
b. Ground section (section to be used when the vehicle is on the ground)

7. Communication systems:
1. Frequency ranges and modulation techniques used for communication
2. Network usage
4. Use of WIFI-WMAX
5. Use of D-MAX communication
6. The use of RADAR systems, the use of warning systems
7. Use of LIDAR systems
8. Use of acoustic systems
9. Acoustic RADARs
10. Use of LASER communication systems,
12. GPS and Navigation network system,
13. GSM air and ground communication base stations,
14. New generation communication systems.

Classic navigation and GPS systems are only two-dimensional with the features of the day. In other words, it gives the latitude and longitude of a geographical point. There is also a need for a height measuring system for air vehicles. We define altitude definitions as "absolute altitude" from sea level and "relative altitude" from altitude in the geographical region of the aircraft. In addition, measuring the speed of the vehicle and time. Briefly, we call it 7D (x, y, z, height, speed, time, relative height) as a seven-dimensional GPS and Navigation

system. The most important difference between these systems used in today's land vehicles is that they are used to determine instantaneous location in volume. This means a new GPS and navigation system. With the new generation of GPS and navigation systems, it is becoming a small model for the world of systems to be installed with purpose to locate in space for volume.

For air vehicles, emergency corridors , safe flight areas, fire fighting, aid support systems, fuel stations, air policemen and security services are needed. There should also be security systems and units to take necessary precautions in air terror attacks. This may be the basic element of a safe flight. This safety may be more important when the vehicle traffic arrives at a certain crowded intensity level.

Inside the air corridor, there must also be security corridors. In other words, it is necessary to open the safety corridors which are opened for empty flights corridors, corridors for safety, shortly airways, police emergency roads, fire emergency roads, and vehicles that are in the accident to minimally damage other flying vehicles.

V. AIR SUPPORT SYSTEMS

Security:
Security to ensure that the communication is secure. Safety to be taken when unmanned aerial vehicles are controlled by others. Security for any terrorist incident. Safety to be taken for air piracy. Hacker or electronic security for fraud or terrorist attacks. It is a unit representing all kinds of security.

Fire Department:
It includes aids to be carried out in the event of a fire in an air vehicle or in a dangerous situation

Police:
It means air police. It means traffic policemen in the air to take precautions for those who violate air traffic. He must be able and willing to intervene at necessary times.

Emergency Aid:
The dangerous situation of air vehicles is also represented by the section responsible for emergency assistance. Among the priorities of this section are reducing human casualty, providing ambulance service, and then helping manned aerial vehicles in the event of an accident caused by unmanned aircrafts.

Fuel Stations:
They are stations set up to meet the fuel needs of aircraft in emergency situations. These stations must be established for the Emergency fuel needs.

Passenger Stops:
They represent centers where passengers will carry out landing-boarding or passenger transfers.

Financial Service Centers:
It is the central systems that will determine the form of payment for the passengers, or which will support the payment without incurring advance payments.

Recovery/Save:
It represents the work done to rescue manned and unmanned vehicles from situations where they do not want to be involved. For example, the interlocking of two vehicles represents the segment to be used for most situations, such as dragging another vehicle. It represents the unit to be set up for emergency help in cases such as hijacking or dragging with a physical object.

Health Centers:
They are the centers to intervene in emergency situations. These should consist of three basic units, including doctors, hospitals and pharmacies.

Passenger Transfer Centers:
According to the classes of aircraft, the transfer of passengers represents centers where new passengers will be taken and landed to and from the station. These can be especially important for buses and trains.

Terminals:
It represents centers where partial service is provided for passenger boarding and landing of air vehicles, especially commercial air vehicles.

Demolition Teams:
It represents the armed security units to be used in dangerous situations in air vehicles, especially in the cases of unmanned aerial vehicles attacking or destroying the vehicles that cause human terrorism.

Social Need Centers:
The main ones are restaurants for food and drink, hotels, bakeries and markets.

Tractors:
It consists of systems that are used to save air vehicles that are failing in the air and safely lower them.

Connection Centers:
It consists of the connection centers to be set up for the transportation of passengers, buses, trains or similar vehicles from air to ground. The characteristics of these centers should be the working characteristics in all kinds of weather conditions. It should consist of the systems and units that should download the people without being affected by the weather conditions by providing the safety of life.

City Planning-Locating:
They represent space occupied by aircraft in case of emergency. These areas are;
a. Emergency landing areas
b. Emergency departure areas
c. Help support / service areas
D. Regular takeoff and landing areas
to. Ground maintenance, repair service support areas should be available.

These areas should be taken into account when doing the city planning. They will be needed after the first quarter of this century. For this reason, city planning should be considered, especially for new settlements. Because there will be no air space everywhere, small vehicles should be planned to use every space like air space.

VI. COMMON FOUNDATION LAW SYSTEM

Detailed legislations for flight systems, equipment, altitude adjustments, roads and fatal accidents, material accidents and all kinds of mortal and material loss caused by flying accidents shall be established by considering all details for flying vehicles. In addition, the regulations must be made considering the altitude and the human, unmanned, public transportation, commercial transportation, etc. Arrangements must be made in advance in accordance with this law. All kinds of situations such as accidents, deaths and material losses in passenger aircraft used today should be taken into consideration and regulations should be made as domestic legal order and international law system. By carrying out a detailed international study, the legal system including international and domestic law should be reorganized. Countries should regulate their domestic law regulations in accordance with the international legal system. Because the events in every part of the world will be similar. As a result, the common legal system for air vehicles in the world must be formed by itself spontaneously.

VII.RESULT AND DİSCUSSİON

Legislation to be prepared for the management of flying vehicles should be more stringent, and clearer than highway road traffic regulation of land vehicles. The reason for this is that the dropping of the aircraft may lead to loss of life and property that does not compensate for the accident in the air and on the ground. The other reason is the need for a new generation GPS and Navigation system to be used in air communication. Currently used systems are working according to latitude and longitude technique. In addition to these systems are relative height, absolute height, speed and time variable. In other words, 7D (x, y, z, height, speed, time, relative height) Navigation and GPS are needed. The laws to be prepared should be compatible with the laws of many countries as much as possible. In the future, many terrorist activities, border violations and smuggling will be done with these air vehicles. In fact, the management of air traffic, in other ways, takes the foundations of establishing and managing cities in the air. For this reason, this should be taken into account when all applications and institutions are created.

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