CONDITIONS FOR USING UAVS IN SOME ECONOMIC SECTORS

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Abstract: *IUAVT, or intelligent unmanned aerial vehicle technology, is a direction that offers promise for resource-rich economies because it is reasonably affordable, dependable, and does not necessitate a high-tech background. UAVs are frequently used for a range of monitoring tasks, including field processing, communication, search, and cargo delivery. UAVs and AI components working together can solve issues automatically or semi-automatically. However, implementing IUAVT in the economy necessitates overcoming a number of obstacles. Precision agriculture, risky geophysical processes, environmental pollution, mineral exploration, wild animals, technical and engineering structures, and traffic monitoring are some of the areas where the research focuses on the potential economic impact of IUAVT in Uzbekistan.*

The review also discusses current methods for overcoming IUAVT's technical, legal, and software-algorithmic limitations. The discussion examines how these restrictions may affect

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INTRODUCTION

When using both traditional and new sectors of the economy, new technologies are a crucial element of a successful economic justification that results in an increase in output and productivity. These technologies relate to data collection, processing, analysis, and application of new management techniques in addition to extraction, processing, and production.

This study examines the potential applications and advantages of using unmanned aerial vehicles (UAVs) in a resource-rich nation like Uzbekistan.

The following fields of application for IUAVT are examined in this paper: Precision agriculture (PA), environmental pollution monitoring (MoEP), monitoring of technical and engineering structures (MoTES), and traffic monitoring (TrM).

Precision Agriculture (PA)

Precision agriculture is a method of managing crop productivity that is based on sophisticated informational, communication, and aeronautical technologies [1]. Only crops that actually need watering and fertilizer are given it, and only sick plants are given chemical treatment. This entails doing all agrotechnical tasks at the most advantageous moment, depending on the unique circumstances, etc., which enables realizing savings of 10% to 50% [2]. There are several components and three primary phases involved in precision agriculture;

- Obtaining in-depth data about the farm, field, culture, and region;
- Analyzing the data to plan agro-technological events and develop solutions;
- Putting various agro-technological events (the application of fertilizers, herbicides, and biophages) into action.

UAVs allow for the full use of precision agriculture's potential, not only for information gathering (such as the creation of precise field maps with all of their features and characteristics, determining soil moisture, identifying pests [3], etc.), but also for decision implementation (such as spot treating with pesticides) [4]. The picture depicts the primary agricultural activities involved in crop cultivation throughout the year (on the left) and the potential involvement of UAVS in meeting PA's task-solving needs (on the right).

The UAV can be fitted with a variety of sensors, however the four that are most frequently used are GPS, a multi/hyperspectral camera, a humidity sensor, and a barometer [4]. Since multispectral camera recording is used to calculate the normalized difference vegetation index (NDVI), which has become one of the most reliable tools for simple and quick remote assessment of plant and crop conditions since 1973, it is crucial to have a camera covering the visible and near-infrared (NIR) range.

$$NDVI = (NIR - Red)/(NIR + Red)$$

To this day, the NDVI is the most common vegetation index used in agriculture.

Two weeks before the naked eye may notice fading crops, NDVI enables agronomists and farmers to spot them in the field. Farmers can discover possible issues, such as illnesses, pests, fungi, or arid zones, and treat the problems quicker and without catastrophic consequences because diseased plants may be readily identified in the infrared range than with the untrained eye.

The findings will significantly influence the growth of the domestic agricultural UAV market and can be used to the international development of agricultural drone solutions.

By 2024, it is anticipated that the global market for agricultural drones will be worth USD 4.8 billion, with the USA continuing to hold the majority of the market [5]. The key drivers of expansion will be rising venture capital funding, public awareness of the advantages of agricultural UAVs, and software for data processing and field research.

The market for agricultural UAVs could be estimated to be worth many tens of millions of dollars by dividing this sum by the country's population and income levels.

It is possible to evaluate the advantages of using precision agriculture models on the main crops grown in Uzbekistan based on the data that is currently available [2]. claims that depending on the crop, the use of precision agriculture increases crop yields by 42 to 80%.

Low field productivity and rising demand for organic products are prerequisites for using UAVs [1]. The Republic of Uzbekistan expects a profit increase of USD 5.4 billion with the widespread adoption of precise agriculture techniques. Without taking into account market characteristics of grain sales, 6% or USD 324 million will be associated with the use of agricultural drones in this situation.

Using machine learning algorithms that are based on processing the heterogeneous data obtained with the use of UAVs, it is necessary to develop models and methods of decision support systems in order to implement precision agriculture systems. In order to perform tasks for plant protection and fertilization, it is necessary to develop models and methods for machine learning-based decision support based on processing the heterogeneous data obtained with the use of UAVs.

Monitoring of Environmental Pollution (MoEP)

Urbanization, mining, and industrial development all contribute to serious environmental pollution. Human health, agriculture, the climate system, and the hydrological cycle are all impacted by environmental pollution. Problems with air pollution are present in rapidly expanding cities. Polluted soil, water, and air all increase mortality and morbidity from respiratory infections, coronary heart disease, lung cancer, cerebrovascular disease, and chronic obstructive pulmonary disease (COPD).

Using UAVs outfitted with cameras of various spectral ranges, a set of sensors, as well as spectrometric and gamma-radiometric equipment, is one of the promising methods for gathering data on environmental pollution [6]. Examples already in existence demonstrate the potential for using UAVs to assess the radiation situation in human-hazardous areas, such as radiation mapping and inspecting forests close to Chernobyl. UAV-based complexes are also used to detect volatile organic compounds (VOC) released during emergencies and to monitor air pollution.

The development of urban areas, the use of coal and oil for energy and heat generation, and the activities of the extractive industry are all contributing factors to the environmental issues in Uzbekistan.

Land and soil contamination is a natural result of the intensive exploitation of natural resources, often without consideration for the effects on the environment. Over 240 thousand hectares of disturbed lands, including overburden and rock dumps, tailing ponds, ash dumps, coal and mining quarries, etc., are located in Uzbekistan, according to data from the land balance for 1 November 2015.

It should be noted that Tashkent, the capital and largest city of Uzbekistan, has among the highest levels of air pollution [7], which has been linked to an increase in chronic obstructive pulmonary disease that is nearly twice as high as the post-Soviet average.

It is anticipated that using UAVs will improve the intensity and quality of control over emissions into the atmosphere, which can reduce industrial environmental violations, the number of smog days, and greenhouse gas emissions into the atmosphere. The use of UAVs for environmental monitoring tasks is constrained by significant economic losses and a threat to public health [8].

Based on the disparate data the UAV board has provided, operational controls of hazardous substance emissions at the production facility and quality assessments of reclamation works must be developed. Increased flight time, payload, accuracy, and sensitivity of sensors, as well as data processing software, including computer vision systems (to evaluate the caliber of remediation work when performing crop protection and fertilization tasks), should be addressed in this area.

Monitoring of Technical and Engineering Structures (MoTES)

The industrial Internet of Things (IIoT) paradigm is the foundation of the new industrial revolution, known as Industry 4.0. A novel business model is offered by the IIoT. These models focus on gathering and processing data over the course of a product's or structure's entire life cycle.

The following are some examples of IIoT application areas: machinery, homes, firefighting apparatus, agricultural systems, mining apparatus and related equipment, medical devices, personal products, and transportation systems and vehicles.

UAVs are employed in monitoring, the creation of 3D models, the detection and evaluation of damage, and other tasks.

UAVs enable quick collection of 3D images, even those from difficult-to-reach locations. For instance, to evaluate the state of wind turbine wings, the obtained images are classified using deep learning . The increasing destruction can be seen thanks to the use of noise sensors. UAVs can be used to monitor large areas of photovoltaic stations if they are also equipped with an infrared camera. UAVs can now be used to monitor steel structures thanks to the addition of more ultrasonic and laser scanners. There are drawbacks to such UAV use as well as benefits, some of which include weight-restricting equipment, flight restrictions, and weather dependence.

The primary requirements for using IUAVT for the monitoring of technical and engineering structures include the requirement to gather data on the state of equipment and facilities, particularly in difficult-to-reach locations for the execution of tasks [9].

To detect and stop errors in their work, as well as to foretell their condition, methods for monitoring engineering structures using computer vision systems and machine learning must be developed. This field should be used to address scientific and technological issues like the creation of software for applications in machine vision, image classification, and indoor flight control.

Traffic Monitoring (TrM)

The main demands placed on IUVT for traffic management tasks include a traffic situation assessment, quick arrival at the scene of any accidents, and perhaps even the delivery of first-aid kits to patients waiting for ambulances. The likelihood of traffic jams and additional costs are decreased by prompt response.

Additionally, data gathering is necessary to address the issue of traffic optimization [3].

Significant economic losses and a threat to public health are the two main requirements for using IUAVT for traffic monitoring [9]. In Uzbekistan, the annual economic losses due to traffic accidents and obstructions are estimated to be around USD 3.3 billion. An economic impact of at least USD 66,000 thousand would result from reducing these UAV-related losses by 2%.

A system of operational road monitoring, identifying potentially hazardous drivers, and traffic forecasting must be researched and developed. The following technical and scientific issues need to be resolved: lengthening the flight time, boosting the processing power of the on-board processors, and addressing the issues with processing large video data streams away from the UAV. The employment of IUAVT is estimated to have a USD 66 million economic impact.

Conclusion

UAV technology has bright futures in a number of economic sectors when combined with intelligent flight planning and data processing techniques. IUAVT's primary purpose is to monitor the surrounding space, gather images, including multispectral ones, and process those images using both onboard and ground-based computing systems. UAVs can organize communication, search, transportation, fertilization, the application of herbicides and biophages, among other tasks, in addition to monitoring.

The economic impact of using UAVs depends on how developed a given industry is in a given nation. Due to the relatively low level of automation in non-extractive industries like agriculture, the economic impact of using new technologies can be multiplicative for resource-oriented economies. The local peculiarities of using the IUAVT are formed by the distinctive characteristics of Uzbekistan related to the air basins of cities' pollution, the presence of significant risks of hazardous geological processes in the southern part of the country, environmental pollution brought on by mining, and the requirement for the development of the mining industry.

Although UAVs are portable, reasonably affordable, and effective, these factors are insufficient for widespread adoption of IUAVT in the various economic sectors. Many technical, legal, and software-algorithmic restrictions must be overcome.

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