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IMPROVING THE TECHNOLOGY OF CREATING INFORMATION BASE OF BUILDINGS AND CONSTRUCTIONS CADASTRE

ABSTRACT

Today, twenty types of cadasters are maintained in order to ensure a single, nationwide, comprehensive accounting and assessment of the natural and economic potential of the Republic of Uzbekistan and its individual regions. This article is aimed at improving geoinformation and cartographic technologies for creating an information database of the state cadastre of buildings and constructions in the unified system of state cadasters. Such improvements are crucial to fostering transparency and enabling more efficient property tax collection practices, which are essential for maintaining an accurate and up-to-date cadastral database. The need for state registration of rights to immovable property is growing. It is known that in order to conduct transactions involving immovable property, such as sale, inheritance, rent, gift, and other activities, the rights to land plots, structures, and constructions must first be registered with the governmental authority. The information gathered via state registration is utilized for land and property tax collection, among other uses. It should be mentioned that the preliminary data is generated as a consequence of assessing the quantitative, qualitative, and legal state of the item based on its registration. These data are produced using the principal data from the state cadastre of structures and constructions. According to research conducted in the research object, following the creation of the primary data, modifications are recorded on the basis of registration, if the owner of the property does not ask for additional data formation. This procedure is intended to take place every five years. It should be mentioned that after completing the activities associated with the objects, namely sale, inheritance, rent, gift, etc., most immovable property owners have been seen to transfer the rights to specific structures and constructions from the state register in a timely way. However, the fact that property owners construct new buildings and constructions based on their needs without architectural designs or consent from the appropriate body weakens the credibility and transparency of cadastral information. More specifically, the cadastral data is leading to inconsistencies with field survey data. To solve such difficulties, we realize the significance of creating state cadastre information on structures and constructions utilizing cutting-edge technologies.

KEYWORDS: state cadastre of buildings and constructions, cadastral information system, GIS, property taxation, technical inventory, cartographic base

INTRODUCTION

The state cadastre of buildings and constructions is maintained in digital form using an information system to ensure the state registration of the rights of owners of buildings and constructions and other users of these objects, as well as the right of ownership of buildings and constructions and other property rights. Like other cadasters, the state cadastre of buildings and constructions is of great importance today, since in our country, during the transition to a digital

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economy, there is a need to quickly obtain information about real estate objects. In particular, as digitalization becomes more integrated into everyday processes, the need for accurate, real-time data has never been more pressing, especially for supporting government policies on urban growth and land resource management. In addition, accurate information about real estate is necessary for the regulation of mortgages, insurance, land, property tax collection, and a number of other purposes. However, it should be recognized that sometimes there are cases where such information is not formulated accurately enough. This may have negative consequences for future real estate transactions. Therefore, it is advisable to systematically form information on the state cadastre of buildings and constructions within real estate.

The conducted analyses show that today the formation of cadastral information on buildings and constructions within the structure of real estate objects by the Cadastre Agency is carried out in three main stages. These are:

- Stage 1 — determination of the technical condition of the object using geodetic measuring instruments and recording it in the information system;
- Stage 2 — drawing up a digital cadastral plan, reflecting the measurement results on a drawing;
- Stage 3 — entering the information obtained in the previous stages into the information system or updating existing data.

While this approach has been effective for the time being, there is growing recognition that the integration of modern technologies could offer more efficient and less resource-intensive solutions.

In recent years, there has been a rapid adoption of advanced geospatial technologies, including digital twins, GeoAI (Geospatial Artificial Intelligence), and cloud-based 3D GIS systems, enabling automated real-time monitoring of real estate, enhancing transparency, and speeding up property registration processes. These innovations offer considerable potential to streamline the registration process and make cadastral data more dynamic and responsive to rapid changes in urban landscapes. GeoAI, in particular, combines machine learning with GIS and can automatically detect unregistered structures and predict development changes based on satellite and drone data, minimizing human intervention. These modern technologies offer significant improvements over the current three-stage process, especially in the timely and accurate identification of property details [*Mefford*, 2025].

Based on the above-mentioned stages, the state cadastral objects of existing buildings and constructions are currently being registered in the republic on the basis of a unified system. According to official data provided by the Cadastre Agency, the total number of objects belonging to individuals and legal entities today is 8 152 229. It should be noted that during the three-stage registration, there is no single method for using technical means, the methods and technologies used do not meet modern requirements, and there are objects that have not been registered due to technical errors during the registration process or a number of other factors. The article considers the issues of expeditious registration of such real estate objects using modern methods and low-cost technologies, timely collection of property tax from newly identified objects, and the creation of reliable information about them.

RESEARCH MATERIALS AND METHODS

To address the challenges associated with the accuracy and timeliness of cadastral data, a series of advanced geospatial technologies and methodologies were utilized in this study. These technologies aim to enhance the precision of property registration and ensure up-to-date cadastral records, which are vital for accurate property tax collection. Modern geospatial tools, such as unmanned aerial vehicles (UAVs) equipped with advanced sensors, and geoinformation systems

(GIS), were employed to assess and update cadastral information across various regions. This approach provides a more efficient way of identifying unregistered structures and minimizing errors in the existing cadastral databases.

According to official data on the state of the cadastre, the restoration of buildings and constructions based on technologies designed for 2021 and 2022 will reach the first level. The diagram below reflects the trends in the formation of geoinformation data for the state cadastre of buildings and constructions for 2017–2021 (Fig. 1).

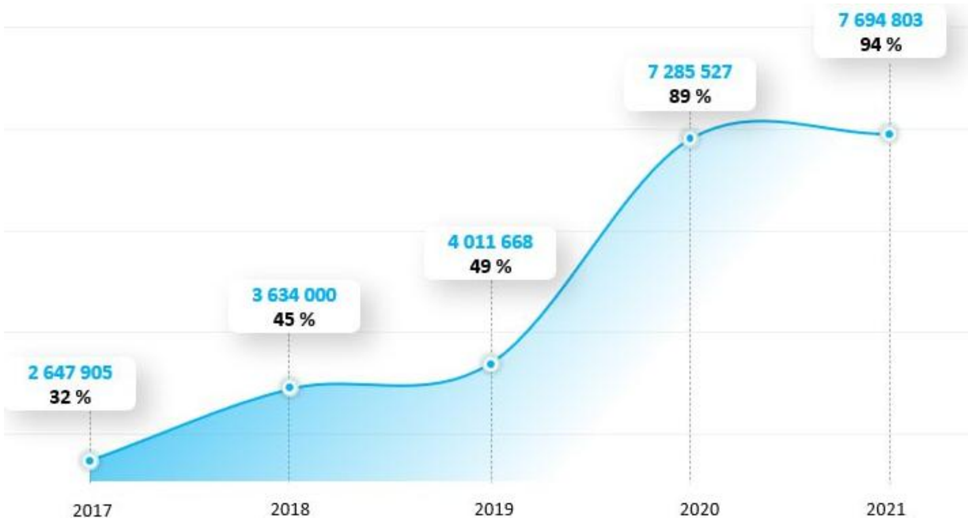


Fig. 1. Trends in the development of geoinformation data (2017–2021)

As shown in Fig. 1, the conducted analysis provides clear evidence of the progressive integration of cadastral information into the unified state system between 2017 and 2021. The observed increase in coverage, particularly the significant leap from 54 % in 2019 to 98 % in 2020, reflects the accelerated implementation of digitalization measures and institutional reforms in the field of cadastral management. Such dynamics not only confirm the reliability and efficiency of the adopted methodological approaches but also demonstrate the prioritization of creating a comprehensive, transparent, and accessible cadastral database as a strategic objective of the Republic of Uzbekistan.

The formation of basic geodata in the creation of objects has been almost completed, covering the entire republic. However, the created information system does not meet the requirements of the Cadastre Agency for the identification of special monographic elements of the official data object. In particular, attention is drawn to the fact that information on buildings and constructions has changed dramatically in 2019–2020, depending on the trend in the formation of geoinformation data. The formation of such rapid information in our next republic causes errors and shortcomings. To clarify the issue, reliable data from the Tashkent Region were analyzed to determine the registration status of the identified objects. In 2020, a total of 735 255 objects were identified in the Tashkent Region. By 2021, this number had increased to 773 327. However, the number of objects recorded in the database with properly issued cadastral documents and officially registered property rights amounted to 599 118. At the same time, 174 209 objects were found to be unregistered. Among them, 160 525 objects had technical inventory documents but their property rights had not been registered, while 13 684 objects did not have any cadastral documents at all. Therefore, the data on these 174 209 objects cannot be considered reliable, because if an object is not registered, any changes made to it will not be recorded. This, in turn, creates the basis for significant errors and shortcomings in the calculation and collection of property tax.

It should be noted that the Cadastral Agency's database includes 735 255 objects, including apartments, individual residential premises and non-residential premises. The database also includes outbuildings of each residential and non-residential premises, that is, several structures of one residential premises (warehouse, shed, bathhouse, etc.). They are constantly changing depending on the needs of citizens. According to specialists from the territorial branches of the Cadastral Chamber of the Tashkent Region, after the construction of structures (warehouse, shed, bathhouse, etc.) is completed, it is necessary to re-state register the object within one month. However, given that these works are carried out on the initiative of citizens, we can assume that there will be certain errors and shortcomings in these works. Therefore, in order to eliminate such shortcomings, the Cadastral Chamber provides for a general inspection once every five years [*Boltayev* et al., 2016]. However, this is a very long period of time, which can significantly reduce the reliability of the information received, which in turn can lead to an increase in the number of illegal structures that do not comply with architectural regulations and incorrect collection of property taxes. In order to form accurate data on this problem, a series of analytical studies were conducted in the Kibray District of the Tashkent Region. As a result of the analysis, it was determined that there are a total of 12 mahalla citizen assemblies in the district: Onkurgan, Yonaryk, May, Chinobod, Baitkurgan, Kipchak, Yangiobod, Tuzel, Matkobulov, Ak Kavak, Kibray and Salor.

According to data from the district, the number of objects included in the unified database in 2021 was 64 079, of which 58 212 were state-registered objects, and 5 861 were unregistered real estate. In order to study the current state of state registration of rights to real estate, determine the level of reliability of the information received, and study other problems in the process of its formation, relevant monographic studies were conducted on the Boston Mahalla of the Chinobod Mahalla citizens' meeting of the Kibray District of the Tashkent Region. In this regard, initially, data covering the boundaries of the Boston Mahalla were obtained.

According to the analysis, 837 land users (in 2021) were found in the research object's single database, with 15 of them being non-residential items. As a consequence of the investigation, it was discovered that the items in the neighborhood section are not fully represented in the single database. In that instance, it was discovered that houses and structures on some property plots were not included in the cadastral database. The goal of the research was to address and clarify this difficulty by employing chronological space images obtained with the Google Earth Pro electronic program.

Given the dynamic nature of land use, with changes in property structures occurring frequently, it is crucial to develop methods for more precise and timely registration of newly built structures. Here, modern technologies offer a promising approach to improving cadastral registration accuracy. Recent advancements in geospatial technologies, such as UAVs equipped with LiDAR systems, multispectral, and thermal sensors, have significantly enhanced the ability to map and monitor real estate. These drones can create detailed point clouds, classify buildings by material and purpose, and enable automated change detection. For example, the DJI Matrice 350 RTK with LiDAR Zenmuse L2 provides high-precision urban mapping, while mobile 3D scanners, like the Leica Pegasus TRK500, facilitate highly accurate digitization of buildings [GeoWeek News, 2025].

Such technologies not only enable the automatic detection of changes in real estate structures but also provide a more efficient way to handle large-scale cadastral databases. By incorporating these advanced technologies into cadastral practices, we can enhance the accuracy of the registration process, reducing errors and ensuring that the state cadastre reflects real-time changes. This is essential for maintaining an up-to-date and reliable cadastral database, which will ultimately contribute to better property tax collection and urban planning.

Fig. 2. Extract of the cadastral map (Boston Area, Kibray District, 2016) showing identification of existing buildings and structures (marked in pink)

Fig. 3. Extract of the cadastral map (Boston Area, Kibray District, 2018). Detection of newly constructed buildings in the settlement area (marked in green)

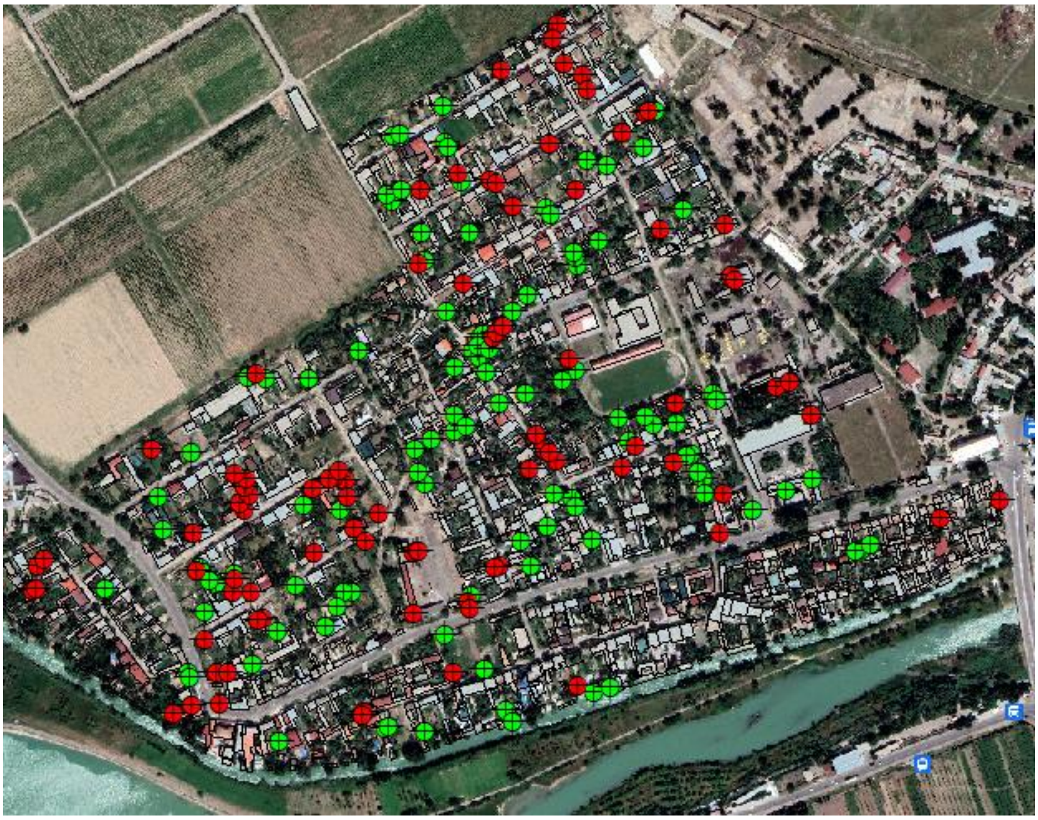


Fig. 4. Extract of the cadastral map (Boston Area, Kibray District, 2020). Detection of newly constructed buildings in the settlement area(marked in red)

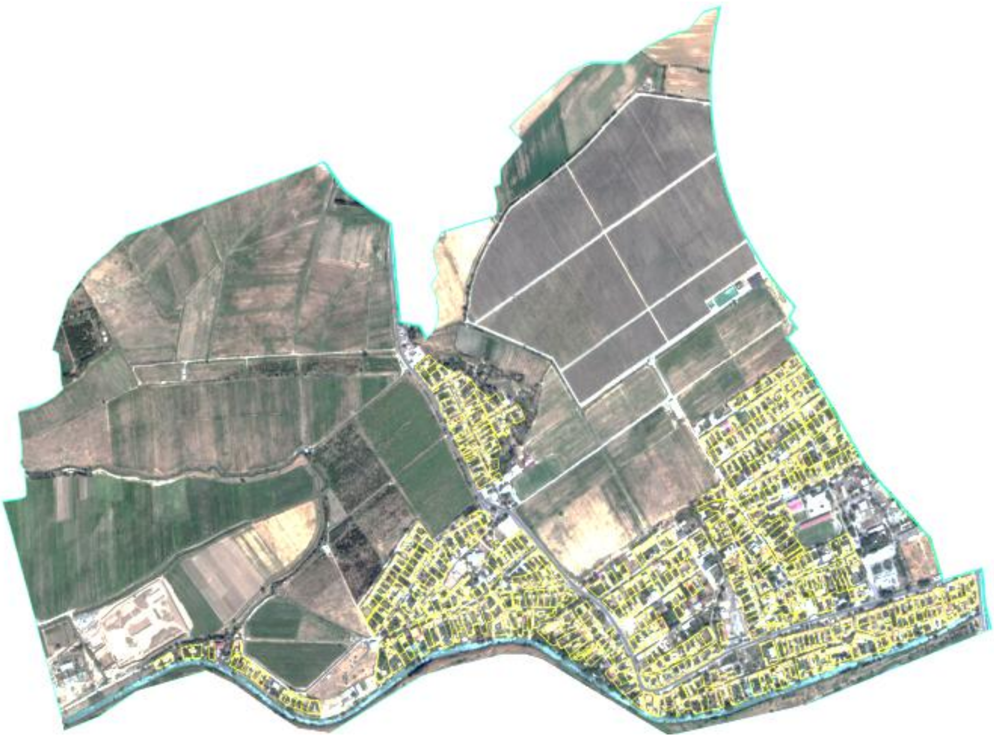


Fig. 5. Extract of the cadastral map (Boston Area, Kibray District, 2021). Registered buildings and structures from the cadastral database (marked in yellow)

To conduct the investigation, satellite imagery from 2016 was used as the cartographic basis. The cadastral data was created and compared to cadastral data acquired between 2018 and 2020. As a consequence, it was discovered that the cadastral data generated in 2016 is out of date for 2018–2020. It is considered that the primary reason for this is because the property's owners want to construct new buildings and constructions. According to the investigation, 109 items were discovered in 2018 and 108 newly erected buildings and constructions in 2020 (Fig. 3–4).

As previously stated, the Republic's scale registers 8 152 229 objects that change regularly. Such changes may be seen in each land user's borders, as well as in the buildings and constructions that sit on them. This necessitates timely state registration of items that have changed.

We recognize that the cadastral basis must be of high precision in order to generate accurate information based on the study findings. That is, a cartographic basis must be established before registration can occur. After the first information is gathered, the further mapping work may be carried out using the goal mapping as the foundation. A basic or multispectral camera can be used to create the cartographic base [*Alipbeki* et al., 2020; *Rakhmonov* et al., 2022].

Multispectral cameras and geographical objects may be classified, allowing for study using specific indices. For example, it is possible to analyze plant vegetation, damages, and other undesirable effects, as well as identify roof coverings for structures and projects. However, due to the high cost and complexity of such technologies, it is recommended to generate the cartographic base for cadastral data using standard cameras.

At the same time, hybrid and cost-effective alternatives can provide valuable support. For instance, satellite imagery offers an affordable and scalable solution for monitoring large areas, detecting changes, and creating base maps. When combined with crowdsourcing approaches, these technologies enable more dynamic and real-time data collection, thereby reducing the need for frequent manual field surveys. Additionally, the integration of AI for data verification, a growing trend in cadastral management, enhances the system's reliability by automating the detection of unregistered buildings and structures, ensuring a more accurate and timely registration process.

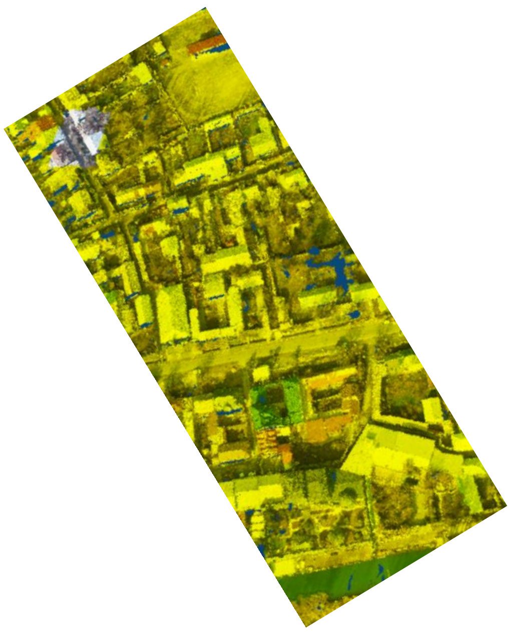
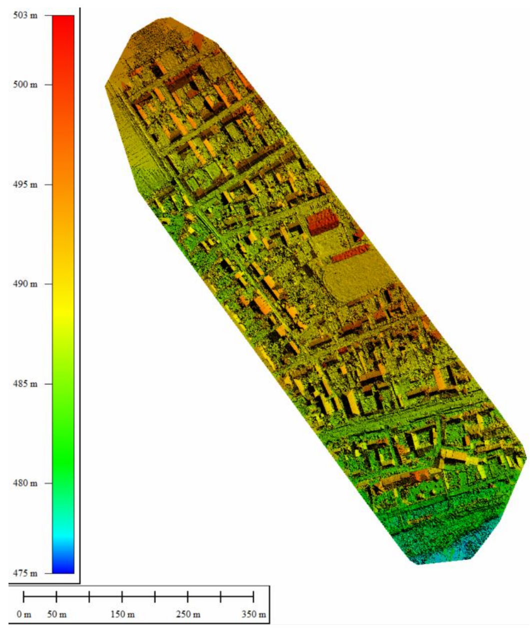
RESEARCH RESULTS AND DISCUSSION

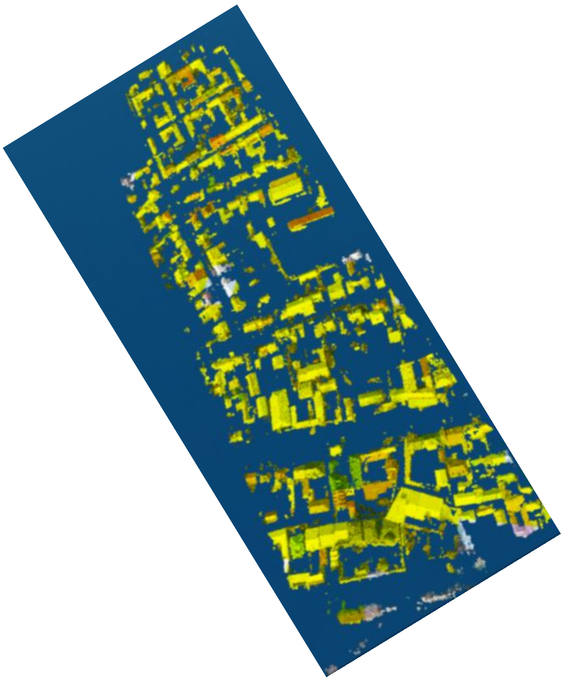
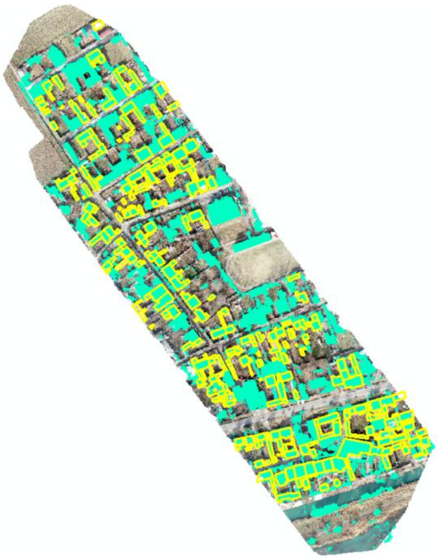
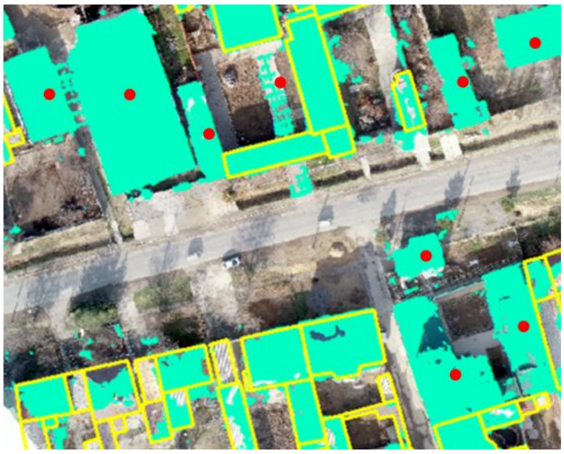
The DJI Phantom 4 Professional quadcopter was selected for the study. In order to use the drone, the Geoinnovation organization was contacted, and with the help of specialists, aerial imagery of the area was obtained at a height of 100 meters. A relatively inexpensive special electronic program, the Pix 4D mapper electronic program from the Swiss company, was used to process the data. This program is distinguished by its automatic processing of photographs taken from the drone. The program is user-friendly and can be applied in cadastral practice with minimal training. Specifically, the cadastral database is compared on the basis of simple technology, and it becomes possible to identify illegal devices or objects that have not been state registered in time, and to have them state registered. This creates an opportunity to bring additional funds to the state treasury in exchange for the timely collection of property taxes.

In addition to these steps, it is also worth noting the potential of deep learning neural networks, such as Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) models, integrated into geospatial systems. These advanced models can further enhance cadastral analysis by automating the classification of objects, detecting changes in real estate over time, and even predicting unauthorized construction growth. Recent studies (2024–2025) have demonstrated that these models achieve up to 92 % accuracy in cadastral object classification tasks [*Hasan* et al., 2025]. This new technological advancement could significantly improve the efficiency and accuracy of cadastral data management, offering a more sophisticated approach to the identification of unregistered structures.

The use of these technologies could complement the existing system described in the algorithm by integrating automatic object detection and change tracking. Such integration would not only make the process faster and more accurate but also reduce human error, ultimately leading to a more reliable and up-to-date cadastral database. It is recommended to perform such work in accordance with the following algorithm (Table 1).

Table 1. The procedure for identifying objects that are missing from the database of state cadastral data

In the 1st step:	**In the 2nd step:**
The registration process begins within a defined neighborhood segment.	A DJI Phantom Pro (or similar) quadcopter is launched at an altitude of 70–100 meters.
In the 3rd step:	**In the 4th step:**
Aerial photographs are captured and processed to generate an orthophoto plan of the study area. 	A cadastral database is created based on the orthophoto plan and registration results. 
In the 5th step:	**In the 6th step:**
The cartographic base is analyzed, and a point cloud is generated. 	A digital elevation model (DEM) of the study area is constructed. 

<table>
<tr><th>In the 7th step:</th><th>In the 8th step:</th></tr>
<tr><td>Buildings and structures are classified according to their height.
</td><td>The fragments of structures and constructions are classified according to their height in comparison to the cadastral basis.
</td></tr>
<tr><th>In the 9th step:</th><th>In the 10th step:</th></tr>
<tr><td>Unregistered cadastral objects are detected.
</td><td>Owners whose objects have failed the state registration process are identified, and they receive notifications about their objects' state registration.
</td></tr>
</table>

In addition, as noted in the preceding sections, it will be possible to identify the observed changes in the area, including newly constructed buildings and constructions, and to transfer them to the state register in a timely manner. These actions, when carried out by a specialist, will enable the identification of objects that are not present in the cadastral database.

CONCLUSIONS

The conclusions of this study are based on the results of an in-depth analysis of the current state of the state cadastre of buildings and constructions in the Republic of Uzbekistan. The research examined statistical data from 2017 to 2021, which demonstrated both the expansion of cadastral coverage and the persistence of inaccuracies related to unregistered or newly constructed buildings. Case studies conducted in the Tashkent Region, including the Kibray District, confirmed that discrepancies remain between cadastral records and field surveys, with a significant proportion of objects either partially registered or absent from the database. The comparative analysis using satellite imagery and aerial surveys further revealed that newly constructed buildings and extensions often appear without timely registration, leading to inconsistencies in property tax collection and reduced reliability of cadastral data. These findings highlight the need to introduce modern geoinformation technologies, such as orthophotoplan-based mapping and unmanned aerial systems, as effective tools for detecting unregistered structures. Furthermore, the study identified shortcomings in the current five-year inspection cycle, which slows the detection of changes in buildings and constructions. The integration of more frequent digital monitoring and automated comparison techniques is therefore justified as a way to increase the accuracy, efficiency, and transparency of cadastral data.

In summary, the recommendations regarding the use of high-precision cartographic bases, geoinformation technologies, and the involvement of specialized organizations are directly supported by the empirical evidence gathered during the study. This ensures that the conclusions are not speculative but are firmly grounded in the observed challenges and practical requirements of the cadastral system.

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