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DEVELOPMENT OF AN INFORMATION SYSTEM FOR PROCESSING ASTRONOMICAL IMAGES USING CLOUD TECHNOLOGIES

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In this study we overview an information system designed to process astronomical images using cloud technologies, emphasizing the system's architecture and its deployment using these technologies. The system, leveraging cloud infrastructure, offers a scalable and efficient solution for handling large volumes of astronomical data, including blurred images captured by CCD cameras. The core of our system's innovation lies in its cloud-based deployment, which facilitates scalability, accessibility, and the efficient processing of data. This approach not only improves the quality of astronomical images but also accelerates the analysis and interpretation of celestial phenomena. Flexible solution architecture allows for the potential incorporation of other algorithms tailored to specific astronomical image processing needs.

The goal of the work is to create an information system that simplifies the process of processing astronomical images, providing effective tools for both professional scientists and amateurs. The system aims to eliminate challenges associated with image blurring due to atmospheric and optical disturbances, and limitations of camera technologies, enhancing the quality and speed of scientific research and expanding the possibilities for astronomical analysis.

Modern astronomical image processing systems face challenges that limit their overall accessibility and adaptability. First and foremost, most of these systems are developed as internal projects of scientific observatories or groups, which significantly complicates access for external users. Such exclusivity hinders interaction with the community of independent researchers and astronomy amateurs. Moreover, limited support for the integration of external mathematical modules and algorithms, often developed without consideration for industry specifications, further narrows the possibilities for customization and the creation of data processing pipelines. The design concept of these systems usually assumes use by highly specialized professionals with access to advanced computational and telescopic resources. This creates a high entry threshold for other participants in the astronomical community, limiting the use of advanced image processing tools to a narrow circle of experts.

The developed information system demonstrates a number of notable advantages achieved through the targeted application of advanced technologies and innovative methods in the process of designing its architecture. A fundamental characteristic of this system is its ability to provide high-speed image processing [1], achieved through the implementation of image processing modules that are notable for their ease of integration and scalability through modern cloud computing solutions.

This approach allows the system to effectively manage massive volumes of data, significantly reducing the time spent on analytical processing and enhancing the overall productivity of research. During the development of the information system, the Lucy-Richardson deconvolution algorithm was integrated, providing the ability to efficiently address one of the biggest problems in astronomical research – the loss of image quality due to atmospheric and other external interferences [2]. This algorithm, notable for its ability to restore details from blurred images, is characterized by the use of a significant amount of computational resources, which can be problematic in monolithic systems that lack scalability. The mentioned image restoration algorithm was successfully integrated into the current platform, providing end-users with a user-friendly interface that encapsulates the implementation of cosmic image processing.

A crucial aspect of this information system is the use of Docker as a tool for automating the deployment and management of software along with the task queue based on Redis in conjunction with its interaction package – Python RQ. This significantly simplifies deployment and dependency management and provides broader capabilities in terms of system scalability.

Furthermore, thanks to the developed architecture of the information system, image processing tasks can be easily scaled and executed using cloud technologies such as AWS Lambda [3]. This allows for efficient processing of large volumes of data without the need to maintain one's own infrastructure, reducing costs and increasing the availability of resources for processing.

Scaling through cloud solutions allows the system to adapt to varying computational resource demands, ensuring that image processing always occurs at optimal speed and efficiency. The use of cloud technologies also contributes to reducing the time for analytical processing and enhances the overall productivity of research, making the system especially valuable to the scientific community in the field of astronomy.

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