resulting regions should be filtered by size and only large ones that may contain a potential object should be used.

One of the fast and efficient methods of background removal is the MOG2 algorithm[3]. In a number of experiments, the average speed of this algorithm is 10 milliseconds per frame. The algorithm developed in this work demonstrates an average time of 8 milliseconds.

Another disadvantage is that if an object moves little or only one of its parts moves, only that part will be found in the image. This disadvantage is partially compensated by capturing the object's neighborhood and can be completely eliminated by periodically using more computationally intensive algorithms to find objects.

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METHODS TO IMPROVE THE PERFORMANCE OF DISTRIBUTED TELECOMMUNICATION SYSTEMS BY CHANGING THEIR ARCHITECTURE

Currently, Internet of Things systems are among the most complex to design, due to the large number of client devices and the even greater amount of data they generate. The data generated by the devices have no value on their own - the main task of any system is to process them by structuring, cleaning, analysis, etc.

As long as the system processes numerical or textual data, the traditional approach using the cloud is suitable for any load, albeit with high latency. But when the system needs to process multimedia data (audio and video), the resource requirements increase significantly. Nowadays, with the development of artificial intelligence algorithms, media processing has begun to include their active use, for example, pattern recognition. However, the use of these algorithms imposes additional resource requirements - some algorithms can get a significant performance boost when running on hardware-accelerated processors or video cards. Also, such systems may have increased requirements for data processing delays, for example, in video surveillance, which makes the cloud-based approach inefficient.

To solve such problems, the Fog Computing paradigm was previously developed, which introduces additional layers of computing nodes between the cloud and the client device. Using this paradigm, it becomes possible to transfer part of the computation to intermediate layers, which reduces the latency relative to client devices and, accordingly, to obtain data processing results faster at each stage.

Given the growing popularity of this paradigm, researchers have begun to develop specific cases of its application in various fields, creating additional or specialized layers and forming clusters of nodes. In the context of video stream processing, this paradigm can be easily applied - a separate layer of computing nodes is allocated for each processing stage, with hardware characteristics that can effectively perform the designated type of task [1].

The stages of video stream processing in video surveillance include: preprocessing, segmentation, feature extraction, and classification. These stages show that the further the processing is carried out, the more the hardware requirements of the nodes increase, but at the same time, the cardinality of the data decreases - at each stage, the node transmits only the results of its processing and a small part of the original data (for example, key frames). In terms of network capacity, nodes in later stages can receive processing results from more nodes than nodes in the previous stage. Also, it can be noted that nodes from later stages can perform tasks from earlier stages, although this is a less efficient use of resources, as simple tasks are more efficiently distributed to weaker nodes.

These statements lead to the conclusion that the exclusive use of nodes for a specific type of task is inefficient, because in the event of load surges or failures, other nodes may not be able to compensate for the lack of resources due to the conceptual limitations of the system.

New research addresses this situation in the context of the ‘service placement problem’, where a service is a container or application that can perform one type of task. Several such services can be placed on a node, and processing optimizations include moving services to other nodes to reduce latency, which is reduced to performing tasks on graphs [2].

Given that this approach does not clearly divide nodes into layers, and large systems can have tens of thousands of computing nodes, nodes should be grouped into sets defined by some attribute, i.e., into clusters or 'communities' [3]. At the same time, the efficiency of the system directly depends on the principle by which clusters are created and rebuilt and under what conditions a task is delegated to another cluster.

At the moment, various methods have been used to solve the problem of cluster formation: from linear programming to Markov chains and genetic algorithms. However, some of the work using these methods takes latency and bandwidth between nodes as the main parameters, expecting that any service can be moved to optimize the architecture. However, this concept is incorrect from a practical point of view, since not every node can perform the service tasks due to its hardware characteristics.

Also, when performing tasks on graphs, it is assumed that the distance matrix has already been built, although in a distributed system, each node may not be aware of all other nodes in the system if there is no SDN or master node to which other nodes are concentrated. On the other hand, their presence is the 'single point of failure' of the system, even if this component can be dynamically redistributed during operation.

Thus, there is a need to develop a method for clustering nodes of a distributed telecommunication system that:

- creates an architecture without a single point of failure and can be initialized from any node;
- contains an algorithm for scanning the network of computing nodes to find the distance matrix;
- when creating clusters, it seeks to optimize delays in data processing chains, taking into account the sets of tasks that can be effectively performed by the nodes.

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Визначення вимог до частоти оновлення інформації для реєстрації руху поїзда

Перспективні методи керування рухом залізничного транспорту передбачають використання координатної інформації про рухомі одиниці. Вона дозволяє реалізувати координатні способи регулювання руху на основі визначення місця розташування поїздів, їх швидкості і прискорення.
Координатна інформація може бути отримана з використанням супутникових систем навігації, локомотивних засобів контролю, точкових колійних датчиків та інших джерел. У всіх цих випадках доцільно проводити статистичну обробку первинних даних. Однією з проблем побудови системи обробки координатної інформації є визначення частоти оновлення інформації, необхідної для реєстрації руху поїзда.
У роботі розглянуто підхід до вибору частоти оновлення інформації за результатами аналізу спектрів дій, що впливають на рух поїзда.

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РЕЙКОВІ КОЛА В ПРИСТРОЯХ ЗАЛІЗНИЧНОЇ АВТОМАТИКИ

Рейкові кола є основним засобом контролю зайнятості ділянок залізничної колії, дія якого закладена в роботу всіх систем керування і регулювання рухом поїздів і яким в значній мірі визначається надійність роботи цих пристроїв і безпека руху поїздів.

У доповіді, окрім загальних відомостей про рейкові кола, розглянуто особливості їх експлуатації в умовах сьогодення на залізницях України, а саме:

- здійснено порівняння рейкових кіл з альтернативними пристроями і засобами контролю вільності ділянок залізничної колії;
- проаналізовано вплив відмов рейкових кіл на якість і безпеку перевізного процесу. Показано частку відмов у роботі рейкових кіл відносно усіх відмов пристроїв залізничної автоматики;
- показано вплив експлуатаційного персоналу на якість і безпеку функціонування рейкових кіл;