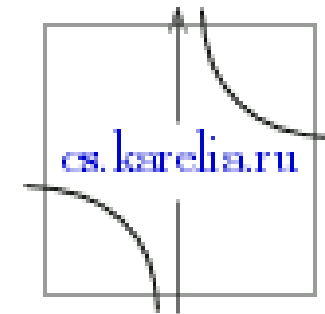




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Edge-Centric Video Data Analytics for Smart Assistance Services in Industrial Systems

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Introduction

Problem:

- Basic video solution: connection between camera and user directly;
- Many solutions based on analysis of individual video stream;
- Lack of solutions of how to create video services based on various and Edge-computing components

How to develop videoservices?

- Multi-platform edge-based monitoring, computing and analytics
- Usage of multiple cameras and services
- Proposal approach: multi-agent architecture of an Edge-centric service-oriented system

Edge-Video Data Analytics

Services:

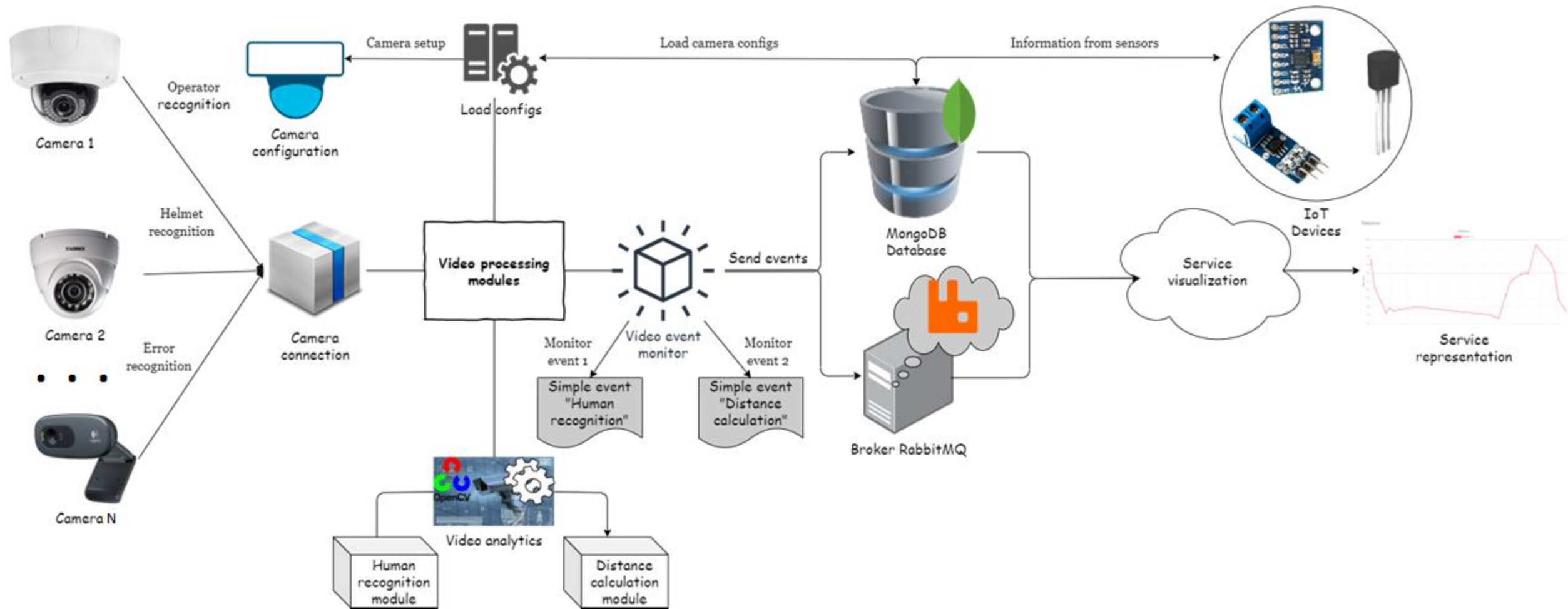
1. Monitoring mechanical components of equipment to detect deviations in machine operations
 2. Operator monitoring in the area to control production processes
 3. Screen image text analysis from CNC display monitor to detect errors
- *Based on basic and composite events*
 - *Multiple devices are used to monitor events*
 - *Computations are distributed among the participants of the Edge network*

Basic and composite events

<i>Service</i>	<i>Composite event</i>	<i>Basic event</i>	<i>Functionality</i>
Monitoring for position and movement of mechanical components	Correct head positioning	Head type recognition, head rotation angle detection	Prevention of breakage of parts of the head mounts, due to incorrect positioning of the head during its installation
	Counterweight Installation Requirements	Head type recognition, shock detection	Prevention of the appearance of defects on the object being processed by the machine, due to the appearance of vibration on the processing head
Monitoring for operator (human) presence in the area	Full uniform availability	Work uniform recognition, helmet recognition	Ensures the implementation of safety measures to protect the health of personnel
	Determining the access level	Human and face recognition, a database of employee qualifications and access levels, object distance detection	Prevention of access to personnel not qualified to operate the machine, to prevent damage due to poor quality maintenance
	Recognition of a person in a danger zone	Human and face recognition, object distance detection	Protection of personnel from being in hazardous areas where a person can be injured as a result of the operation of the machine
Monitoring for text messages observed on the equipment display	Error code with detailed description	Error code recognition, a database compiled from the official CNC error manual	Providing the operator with real-time error information, which will allow faster correction of errors and ensure the smooth operation of the machine
	Related errors	Recognition of error codes	Tracking error chains when a lot of errors appear, to accurately identify the problem and fix it as soon as possible

- **Basic events** - significant phenomena in video streams
- **Composite events** - combination of interrelated basic events
- Composite events are divided into basic with provided functionality

Architecture of an Edge-centric service-oriented system



Personnel monitoring to control production processes



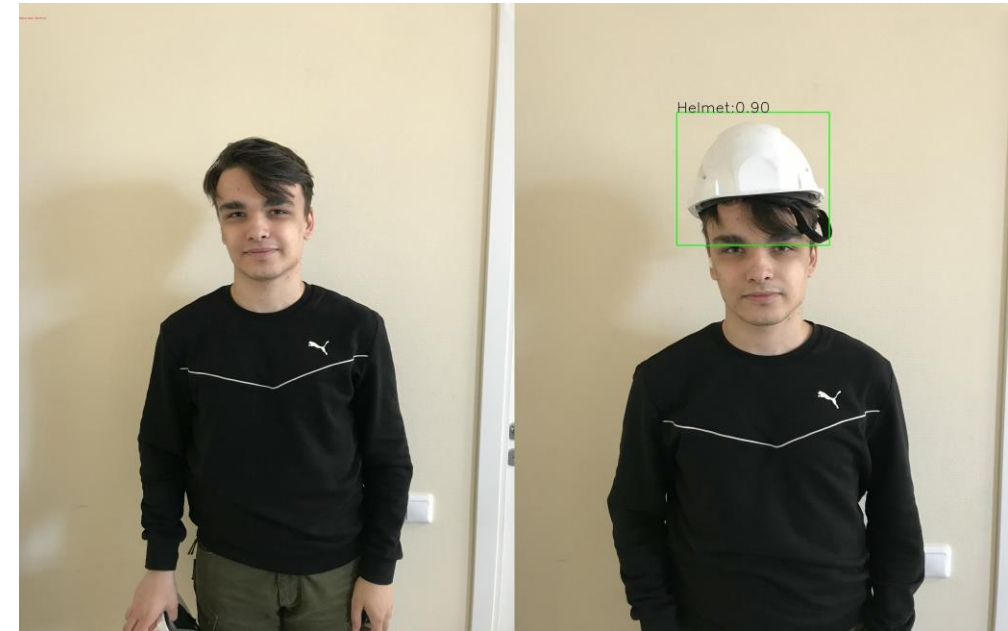
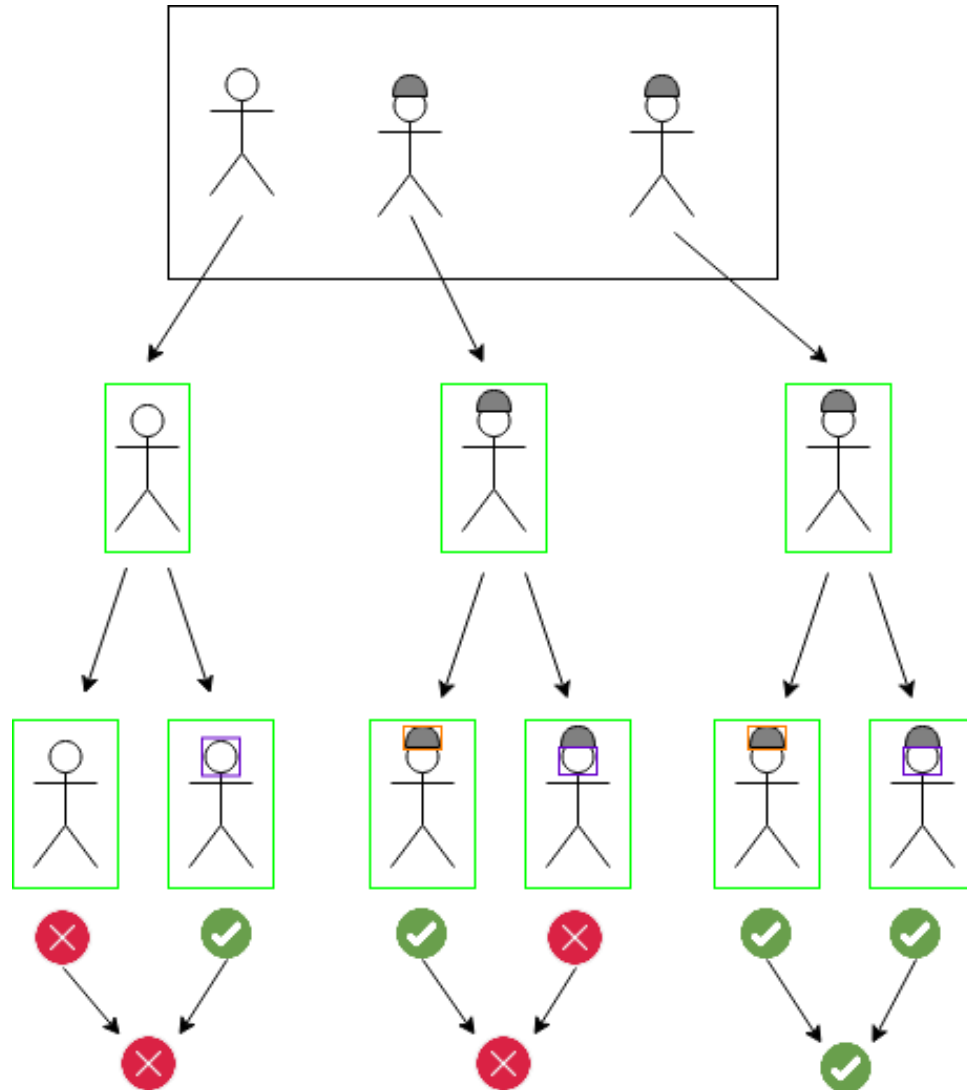
Recognition of people in the operator's area



Recognition of a person in a hazardous work area

- Multiple cameras are installed to monitor different areas
- Real-time analytics based on local server computing
- Interaction with sensors installed near the equipment, displaying the state of the turned on machine to warn the personnel

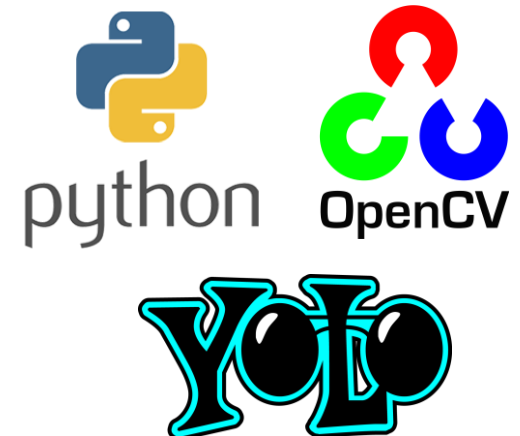
Personnel face and helmet recognition



Without helmet

With helmet

- Helmet tracking on personnel helps to ensure safety and life-saving measures



Monitoring mechanical components



Monitoring mechanical components of equipment to detect deviations in machine operations

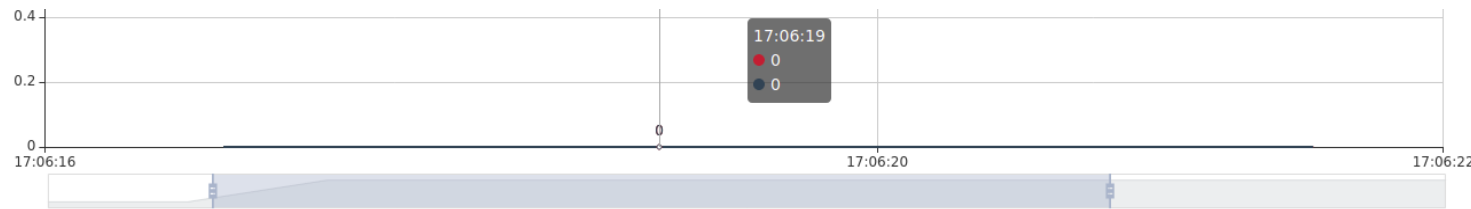
Tracking current location of:

- machining head;
- current angle of rotation
- Based on the search for circles and deviations in the rotation of the head using a fast neural network

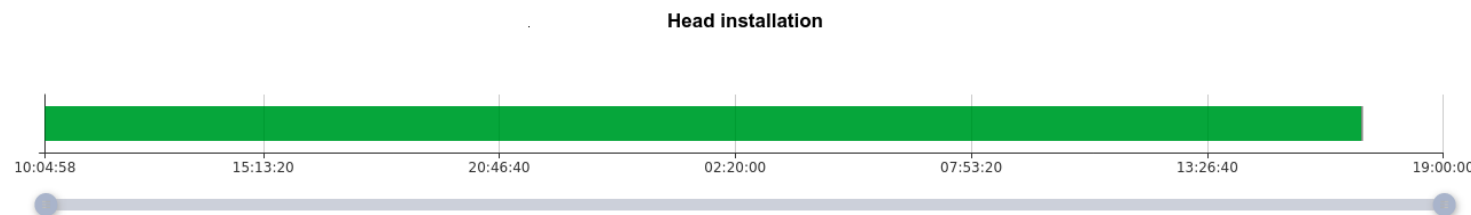
Head positioning and angle detection (Web)



Current camera image showing head position and angle



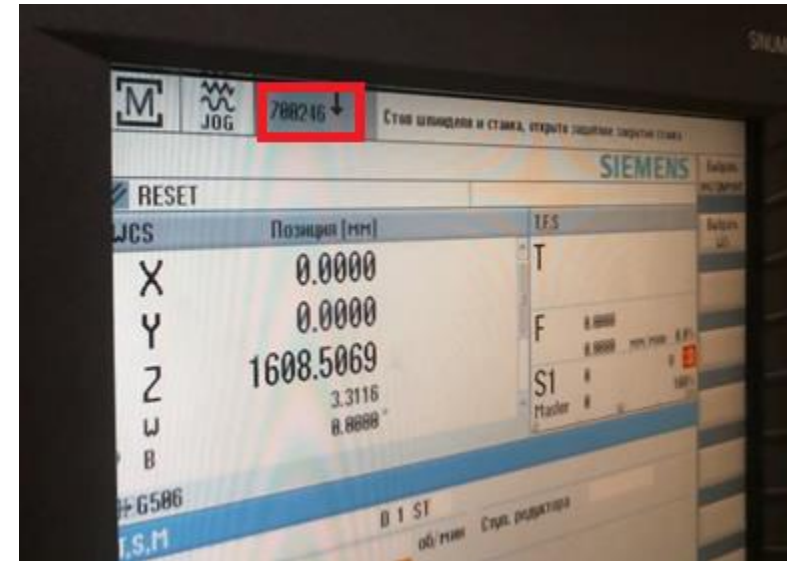
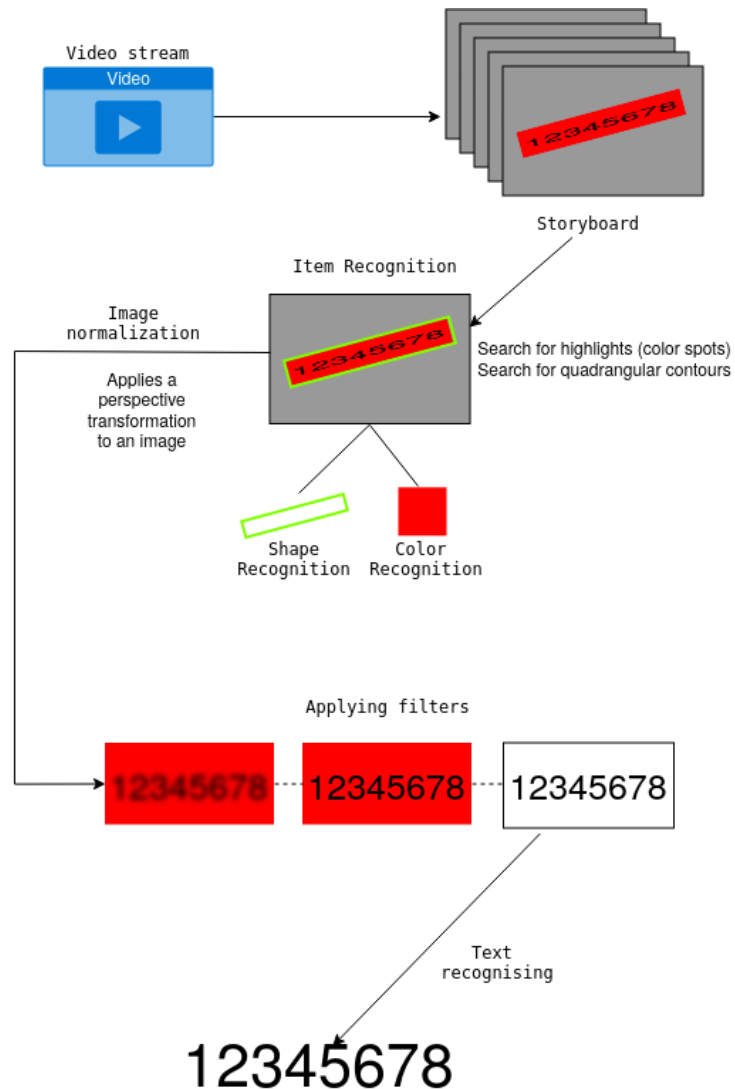
Graph showing the angle of rotation of the heads



Color scheme showing a correctly installed head at any given time

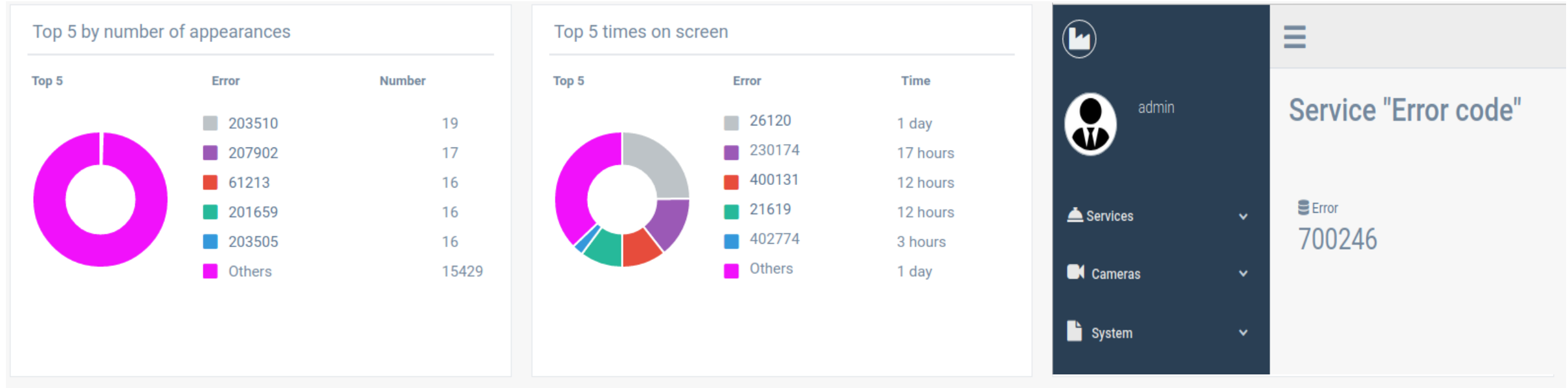


Screen image text analysis from CNC display monitor



- Based on **Raspberry Pi** Camera
- 1) Color scheme recognition
 - 2) Recognition of geometric shapes
 - 3) Affine transformations
 - 4) Applying filters to an image
 - 5) Text recognition

Error code with detailed description (Web)



Top most common errors

Top errors on the screen for more time

Current error on the Web page



Conclusion

Results

Services based on Edge-Video Data Analytics:

- Monitoring mechanical components of equipment to detect deviations in machine operations
- Personnel presence in the area to control production processes
- Screen image text analysis from CNC display monitor to detect errors

Proposal approach: multi-agent architecture of an Edge-centric service-oriented system

Monitoring basic events and building complex events

Thank you for attention!
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