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DEVELOPMENT OF SMART GLASSES FOR SUPPORTING MARINER DECISION-MAKING WITH ECDIS DATA

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Introduction. Ensuring navigational safety and mitigating human error in maritime navigation is crucial. The development of specialized glasses with an integrated camera and internal display screen is proposed as a key innovation. This concept involves the following aspects:

Navigational Dependence and Equipment Usage. Mariners often rely on various navigational tools, including the Electronic Chart Display and Information System (ECDIS), which visualizes electronic cartography showing the vessel, water bodies, other ships, hazardous isobaths, and other critical objects. However, the risk of insufficient control due to human error could lead to navigational mistakes.

Main Idea and Implementation.

1. *Smart Glasses Development:*

Design: Glasses equipped with a camera that scans the ECDIS screen every second and a lens that acts as an internal display for navigation information.

Functionality: Allows the mariner to be continuously informed about the navigational situation without needing to look away from the main view.

2. *Data Processing:*

Collection and Analysis: A specialized program uses neural networks to analyze normalized screenshots, identifying critical changes and potential hazards.

Alerts: The program generates warnings about the most dangerous elements on the chart (e.g., approaching vessels, isobaths, shallows) and displays them on the internal screen of the glasses.

3. Interactive Alerts:

Visual and Audio Signals: The color of the message text changes depending on the level of danger, with an added sound signal to enhance the mariner's attention during critical moments.

Prioritization: The system also considers the time to potential threats, increasing the visual and auditory intensity of warnings.

4. *Camera Focus on ECDIS Screen During Movement:*

Ensuring the camera in the glasses maintains a clear focus on the ECDIS screen while the mariner moves around the bridge is crucial, requiring the development and integration of appropriate technologies.

The main material of the research thesis.

Therefore, taking into account the above, the task of developing an innovative tool to improve the safety and efficiency of navigation of shipmasters with the help of specialized glasses arises. This would also be appropriate if crew members are in poor health or under stress [1]. To implement the proposed solutions, a detailed plan for software and hardware implementation of the idea was developed:

1. Software Implementation:

1.1. Neural Network Development for ECDIS Screenshots Analysis:

Training the model with large datasets to identify objects and hazardous elements on the ECDIS screen using convolutional neural networks (CNNs).

1.2. Detection and Alert System:

Developing algorithms to analyze normalized screenshots for potential hazards and generating textual warnings with color changes and sound alerts for high-risk scenarios.

1.3. User Interface:

Creating a convenient and intuitive interface, including normal visualization and internal screen for alerts, with customizable alert sensitivity and danger types.

2. Hardware Implementation:

2.1. Component Selection:

Glasses with an integrated camera and lens used as a display, high-quality display and camera for rapid image transmission, and a microcomputer like Raspberry Pi for data processing [2].

2.2. Integration with ECDIS:

Developing software for real-time image reading and analysis from ECDIS and accurate transmission of navigational information between ECDIS and glasses.

2.3. Power Supply and Mobility:

Selecting batteries with sufficient operational time for prolonged use and ensuring the glasses are lightweight and comfortable in harsh conditions.

3. Testing and Optimization:

Field Tests: Evaluating the system's effectiveness and reliability in real conditions and gathering feedback from mariners to further refine functionality and interface [3].

4. Technological Solutions for Stabilization and Focusing:

Image Stabilization: Incorporating optical and electronic stabilization to compensate for head movements.

Autofocus: Using contrast and phase detection autofocus for quick and effective focusing.

ECDIS Tracking: Employing machine vision and artificial intelligence algorithms for ECDIS identification and tracking [4].

Lighting Adaptation: Implementing HDR and automatic adjustments for white balance and ISO to ensure high-quality imaging.

Conclusion. The proposed technology reduces the impact of human error by automating the detection and response to navigational threats [5–7]. Instead of constantly monitoring multiple displays, the mariner receives essential information directly in front of their eyes, allowing for quicker responses to changes in the navigational environment. This not only reduces the likelihood of errors but also enhances the overall marine safety [8, 9]. The development and implementation of such glasses could significantly contribute to the maritime industry, enhancing safety, efficiency, and autonomy of mariners in managing maritime vessels.

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