

Hybrid Color-Key Steganography Web Application and Gamified Learning Environment

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In the context of the rapid development of digital technologies and the widespread use of information systems, cybersecurity has become one of the main challenges of modern society. In the process of information protection, approaches that ensure the concealment of not only the content of data, but also the fact of their existence are gaining special importance. In this context, steganography is an effective tool, however, most of the existing solutions are based on static keys and do not take into account the human factor and the need to improve the level of cybersecurity awareness of users. This problem increases the risk of information discovery and unauthorized access, especially in an environment where the user is an active participant in the process. The presented work aims to develop a hybrid steganographic web application based on the Color-Key algorithm, which combines the color characteristics of a digital image and the password entered by the user for dynamic, context-dependent key generation. The proposed approach is based on LSB steganography, SHA-256 hashing mechanism and AES encryption, which provides both data hiding and a high level of confidentiality. In addition, the platform is integrated with a gamified learning environment, which promotes the development of practical cybersecurity skills through interactive tasks such as Capture The Flag. As a result, the work offers a unified model of technological and educational components that reduces risks associated with the human factor and increases the level of cybersecurity awareness.