#HashEx
BLOCKCHAIN SECURITY

ERC721A

smart contracts final audit report

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Contents

1. Disclaimer

This is a limited report on our findings based on our analysis, in accordance with good industry practice at the date of this report, in relation to cybersecurity vulnerabilities and issues in the framework and algorithms based on smart contracts, the details of which are set out in this report. In order to get a full view of our analysis, it is crucial for you to read the full report. While we have done our best in conducting our analysis and producing this report, it is important to note that you should not rely on this report and cannot claim against us on the basis of what it says or doesn't say, or how we produced it, and it is important for you to conduct your own independent investigations before making any decisions. We go into more detail on this in the disclaimer below – please make sure to read it in full.

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2. Overview

HashEx was commissioned to perform an audit of the ERC721A contract from the erc721a.org project. The audit was conducted between 2022-03-09 and 2022-03-10.

The purpose of this audit was to achieve the following:

- Identify potential security issues with smart contracts
- Formally check the logic behind given smart contracts.

Information in this report should be used for understanding the risk exposure of smart contracts, and as a guide to improving the security posture of smart contracts by remediating the issues that were identified.

The code is available at @chiru-labs/ERC721A GitHub repository and was audited after the e03a377 commit.

2.1 Summary

Project name	ERC721A
URL	https://www.erc721a.org
Platform	Ethereum
Language	Solidity

2.2 Contracts

Name	Address
ERC721A	

3. Found issues

Medium	1 (25%)
Info	3 (75%)

C1. ERC721A

ID	Severity	Title	Status
C1-01	Medium	Unsafe math	Open
C1-02	Info	Only sequential minting is possible	Open
C1-03	Info	Revert without a reason	Open
C1-04	Info	tokenURI() return data	Open

4. Contracts

C1. ERC721A

Overview

ERC721 standard token, a fork of chiru-labs verison with a customized token numeration (starting from 1 instead of 0). According to the documentation, the code is inspired by ERC721Enumerable extension from the OpenZeppelin library, but with several gas optimizations.

Issues

C1-01 Unsafe math

Medium Open

Minting function uses `unchecked` math and therefore should have proper warnings about the `quantity` parameter. Any user-interacting functions with internal calls to `_mint()` must check the parameters for over- and underflow.

Recommendation

We recommend to specify this remark in the NatSpec description and in the project documentation. Any project that forks this code should limit the `quantity` parameter to some range.

C1-02 Only sequential minting is possible

Info Open

Anyone who wants to implement the random or a user-defined minting order would face difficulties with ERC721A and should probably use OpenZeppelin versions.

C1-03 Revert without a reason

Info Open

Reentrancy protection revert at L409 should have a reason (or an error message):

```
if (_currentIndex != startTokenId) revert();
```

C1-04 tokenURI() return data

Info Open

`tokenURI()` returned string is always ended with `tokenId` without an extension. `tokenURI()` returns zero length string if `_baseURI()` hasn't been set.

Assumes serials are sequentially minted starting at `_startTokenId()`.

Assumes that an owner cannot have more than `2**64 - 1` (max value of `uint64`) of supply.

Assumes that the maximum token id cannot exceed `2**256 - 1` (max value of `uint256`).

5. Conclusion

1 medium severity and 3 informational severity issues were found during the audit. The contracts are well tested. ERC721A contract conforms to the ERC721 token standard.

This audit includes recommendations on code improvement and preventing potential attacks.

Appendix A. Issues' severity classification

- **Critical.** Issues that may cause an unlimited loss of funds or entirely break the contract workflow. Malicious code (including malicious modification of libraries) is also treated as a critical severity issue. These issues must be fixed before deployments or fixed in already running projects as soon as possible.
- **High.** Issues that may lead to a limited loss of funds, break interaction with users, or other contracts under specific conditions. Also, issues in a smart contract, that allow a privileged account the ability to steal or block other users' funds.
- **Medium.** Issues that do not lead to a loss of funds directly, but break the contract logic. May lead to failures in contracts operation.
- **Low.** Issues that are of a non-optimal code character, for instance, gas optimization tips, unused variables, errors in messages.
- **Informational.** Issues that do not impact the contract operation. Usually, informational severity issues are related to code best practices, e.g. style guide.

Appendix B. List of examined issue types

- Business logic overview
- Functionality checks
- Following best practices
- Access control and authorization
- Reentrancy attacks
- Front-run attacks
- DoS with (unexpected) revert
- DoS with block gas limit
- Transaction-ordering dependence
- ERC/BEP and other standards violation
- Unchecked math
- Implicit visibility levels
- Excessive gas usage
- Timestamp dependence
- Forcibly sending ether to a contract
- Weak sources of randomness
- Shadowing state variables
- Usage of deprecated code

8. Slither ERC721 check

```
# Check ERC721A

## Check functions
[+] balanceOf(address) is present
        [+] balanceOf(address) -> () (correct return value)
        [+] balanceOf(address) is view
[+] ownerOf(uint256) is present
        [+] ownerOf(uint256) -> () (correct return value)
        [+] ownerOf(uint256) is view
[+] safeTransferFrom(address,address,uint256,bytes) is present
        [+] safeTransferFrom(address,address,uint256,bytes) -> () (correct return type)
        [+] Transfer(address,address,uint256) is emitted
[+] safeTransferFrom(address,address,uint256) is present
        [+] safeTransferFrom(address,address,uint256) -> () (correct return type)
        [+] Transfer(address,address,uint256) is emitted
[+] transferFrom(address,address,uint256) is present
        [+] transferFrom(address,address,uint256) -> () (correct return type)
        [+] Transfer(address,address,uint256) is emitted
[+] approve(address,uint256) is present
        [+] approve(address,uint256) -> () (correct return type)
        [+] Approval(address,address,uint256) is emitted
[+] setApprovalForAll(address,bool) is present
        [+] setApprovalForAll(address,bool) -> () (correct return type)
        [+] ApprovalForAll(address,address,bool) is emitted
[+] getApproved(uint256) is present
        [+] getApproved(uint256) -> () (correct return value)
        [+] getApproved(uint256) is view
[+] isApprovedForAll(address,address) is present
        [+] isApprovedForAll(address,address) -> () (correct return value)
        [+] isApprovedForAll(address,address) is view
[+] supportsInterface(bytes4) is present
        [+] supportsInterface(bytes4) -> () (correct return value)
        [+] supportsInterface(bytes4) is view
[+] name() is present
        [+] name() -> () (correct return value)
        [+] name() is view
[+] symbol() is present
        [+] symbol() -> () (correct return value)
[+] tokenURI(uint256) is present
```

```
        [+] tokenURI(uint256) -> () (correct return value)

## Check events
[+] Transfer(address,address,uint256) is present
        [+] parameter 0 is indexed
        [+] parameter 1 is indexed
        [+] parameter 2 is indexed
[+] Approval(address,address,uint256) is present
        [+] parameter 0 is indexed
        [+] parameter 1 is indexed
        [+] parameter 2 is indexed
[+] ApprovalForAll(address,address,bool) is present
        [+] parameter 0 is indexed
        [+] parameter 1 is indexed
```

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