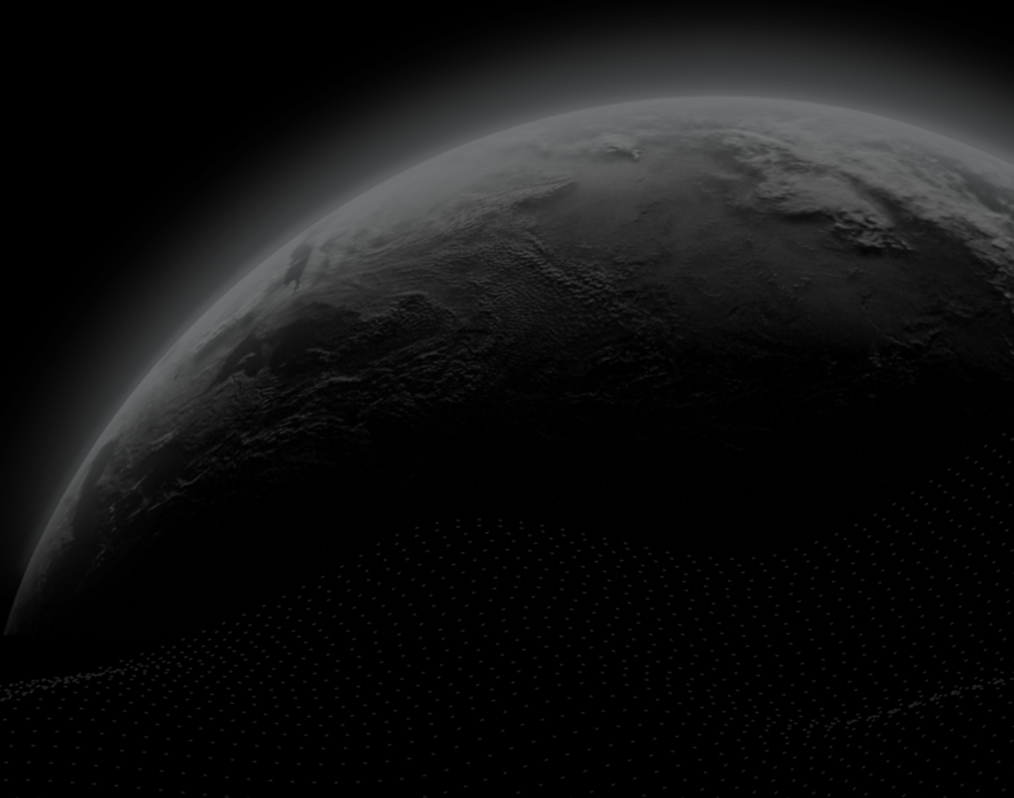
Security Assessment

Lillius - Audit

CertiK Verified on Mar 22nd, 2023



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The security assessment was prepared by CertiK, the leader in Web3.0 security.

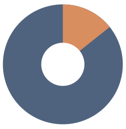
Executive Summary

TYPES	ECOSYSTEM	METHODS
ERC-20	Polygon (MATIC)	Manual Review, Static Analysis

LANGUAGE	TIMELINE	KEY COMPONENTS
Solidity	Delivered on 03/22/2023	N/A

CODEBASE	COMMITS
https://github.com/LilliusApp/LLT/tree/main ...View All	9b48e2f1daf958b2223158dc59023cef60fed558 fbb9cc9985746234dcb746666a112c7debfb7acf ...View All

Vulnerability Summary



7	7	0	0	0	0	0
Total Findings	Resolved	Mitigated	Partially Resolved	Acknowledged	Declined	Unresolved

0	Critical		Critical risks are those that impact the safe functioning of a platform and must be addressed before launch. Users should not invest in any project with outstanding critical risks.
1	Major	1 Resolved	Major risks can include centralization issues and logical errors. Under specific circumstances, these major risks can lead to loss of funds and/or control of the project.
0	Medium		Medium risks may not pose a direct risk to users' funds, but they can affect the overall functioning of a platform.
0	Minor		Minor risks can be any of the above, but on a smaller scale. They generally do not compromise the overall integrity of the project, but they may be less efficient than other solutions.
6	Informational	6 Resolved	Informational errors are often recommendations to improve the style of the code or certain operations to fall within industry best practices. They usually do not affect the overall functioning of the code.

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CODEBASE | LILLIUS - AUDIT

Repository

https://github.com/LilliusApp/LLT/tree/main

Commit

9b48e2f1daf958b2223158dc59023cef60fed558
fbb9cc9985746234dcb746666a112c7debfb7acf

AUDIT SCOPE | LILLIUS - AUDIT

1 file audited • 1 file with Resolved findings

ID	File	SHA256 Checksum
ERC	lillius(ERC-20).sol	6040828b3534fea0b43463e4b817b740a6ad82254b66d54c8152edbf91220a5c

APPROACH & METHODS | LILLIUS - AUDIT

This report has been prepared for Lillius to discover issues and vulnerabilities in the source code of the Lillius - Audit project as well as any contract dependencies that were not part of an officially recognized library. A comprehensive examination has been performed, utilizing Manual Review and Static Analysis techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifications and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

The security assessment resulted in findings that ranged from critical to informational. We recommend addressing these findings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective:

- Testing the smart contracts against both common and uncommon attack vectors;
- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verified in public;
- Provide more transparency on privileged activities once the protocol is live.

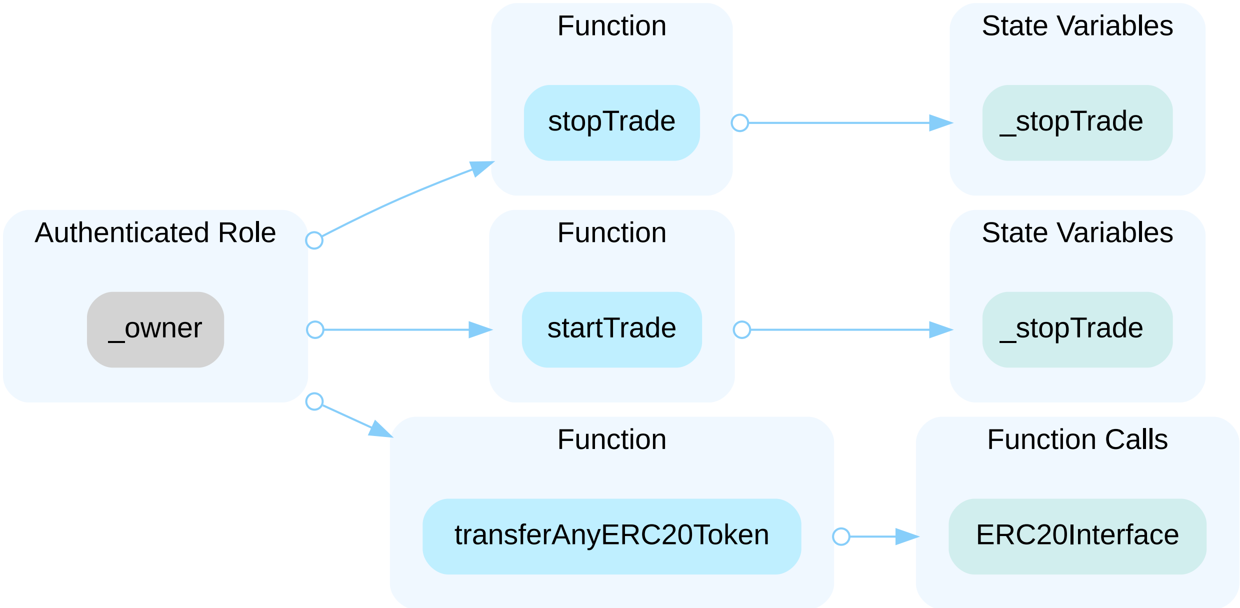
REVIEW NOTES | LILLIUS - AUDIT

LILLIUS aims to deliver a blockchain-based Web 3.0 T2E (Training to Earn) reward platform that utilizes their LILLIUS AI Motion Analysis Technology through smartphone camera. This contract in the audit scope is an ERC20 token.

DECENTRALIZATION EFFORTS | LILLIUS - AUDIT

Description

In the contract `LLTTokenToken` the role `_owner` has authority over the functions shown in the diagram below. Any compromise to the `_owner` account may allow the hacker to take advantage of this authority.



Recommendations

The risk describes the current project design and potentially makes iterations to improve in the security operation and level of decentralization, which in most cases cannot be resolved entirely at the present stage. We advise the client to carefully manage the privileged account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., multisignature wallets. Indicatively, here are some feasible suggestions that would also mitigate the potential risk at a different level in terms of short-term, long-term and permanent:

Short Term:

Timelock and Multi sign (⅔, ⅗) combination *mitigate* by delaying the sensitive operation and avoiding a single point of key management failure.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key compromised;
  AND

- A medium/blog link for sharing the timelock contract and multi-signers addresses information with the public audience.

Long Term:

Timelock and DAO, the combination, *mitigate* by applying decentralization and transparency.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.
  AND
- A medium/blog link for sharing the timelock contract, multi-signers addresses, and DAO information with the public audience.

Permanent:

Renouncing the ownership or removing the function can be considered *fully resolved*.

- Renounce the ownership and never claim back the privileged roles.
  OR
- Remove the risky functionality.

THIRD-PARTY DEPENDENCY | LILLIUS - AUDIT

Description

The contract is serving as the underlying entity to interact with one or more third-party protocols. The scope of the audit treats third-party entities as black boxes and assume their functional correctness. However, in the real world, third parties can be compromised and this may lead to lost or stolen assets. In addition, upgrades of third parties can possibly create severe impacts, such as increasing fees of third parties, migrating to new LP pools, etc.

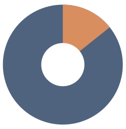
```
    function approveAndCall(address spender, uint tokens, bytes memory data) public returns (bool success) {
        ...
        ApproveAndCallFallBack(spender).receiveApproval(msg.sender, tokens, address(this), data);
        ...
    }
}
```

- The contract `LLTTokenToken` interacts with third-party contract `ApproveAndCallFallBack`.

Recommendations

We understand that the business logic requires interaction with the third parties. We encourage the team to constantly monitor the statuses of third parties to mitigate the side effects when unexpected activities are observed.

FINDINGS | LILLIUS - AUDIT



7	0	1	0	0	6
Total Findings	Critical	Major	Medium	Minor	Informational

This report has been prepared to discover issues and vulnerabilities for Lillius - Audit. Through this audit, we have uncovered 7 issues ranging from different severity levels. Utilizing the techniques of Manual Review & Static Analysis to complement rigorous manual code reviews, we discovered the following findings:

ID	Title	Category	Severity	Status
ERC-05	**Initial Token Distribution**	**Centralization / Privilege**	**Major**	**Resolved**
ERC-02	Missing Emit Events	Coding Style	Informational	Resolved
ERC-03	Missing Error Messages	Coding Style	Informational	Resolved
ERC-04	Solidity Version Not Recommended	Language Specific	Informational	Resolved
ERC-06	Comparison To Boolean Constant	Coding Style	Informational	Resolved
ERC-07	Redundant Codes	Coding Style	Informational	Resolved
ERC-08	Missing Checks In ApproveAndCall	Logical Issue	Informational	Resolved

ERC-05 | INITIAL TOKEN DISTRIBUTION

Category	Severity	Location	Status
Centralization / Privilege	**Major**	**lillius(ERC-20).sol: 107**	**Resolved**

Description

All LLT tokens are sent to the contract deployer when deploying the contract. This is a potential centralization risk as the deployer can distribute LLT tokens without the consensus of the community.

Recommendation

We recommend transparency through providing a breakdown of the intended initial token distribution in a public location. We also recommend the team make an effort to restrict the access of the corresponding private key.

Alleviation

The team published their distribution plan in their github:

https://github.com/LilliusApp/LLT/blob/main/LLT_Initial%20Token%20Distribution%20plan.jpeg

ERC-02 | MISSING EMIT EVENTS

Category	Severity	Location	Status
Coding Style	● Informational	lillius(ERC-20).sol: 123, 132	● Resolved

Description

There should always be events emitted in the sensitive functions that are controlled by centralization roles.

Recommendation

It is recommended emitting events for the sensitive functions that are controlled by centralization roles.

Alleviation

The team heeded our advice and resolved the issue in commit fbb9cc9985746234dcb746666a112c7debfb7acf.

ERC-03 | MISSING ERROR MESSAGES

Category	Severity	Location	Status
Coding Style	Informational	lillius(ERC-20).sol: 20, 23, 28, 31, 75, 124, 133, 152, 153, 171, 189, 190, 191, 208, 220	Resolved

Description

The **require** can be used to check for conditions and throw an exception if the condition is not met. It is better to provide a string message containing details about the error that will be passed back to the caller.

Recommendation

We advise adding error messages to the linked **require** statements.

Alleviation

The team heeded our advice and resolved the issue in commit fbb9cc9985746234dcb746666a112c7debfb7acf.

ERC-04 | SOLIDITY VERSION NOT RECOMMENDED

Category	Severity	Location	Status
Language Specific	Informational	lillius(ERC-20).sol: 1	Resolved

Description

Solidity frequently releases new compiler versions. Using an old version prevents access to new Solidity security features. We also recommend avoiding complex `pragma` statements.

```
Pragma version^0.5.0 (lillius/lillius(ERC-20).sol#1) allows old versions
```

```
1  pragma solidity ^0.5.0;
```

Recommendation

We recommend deploying with any of the following Solidity versions:

- 0.5.16 - 0.5.17
- 0.6.11 - 0.6.12
- 0.7.5 - 0.7.6
- 0.8.16

The recommendations take into account:

- Risks related to recent releases
- Risks of complex code generation changes
- Risks of new language features
- Risks of known bugs

Use a simple pragma version that allows any of these versions. But, consider using the latest version of Solidity for testing.

Alleviation

The team heeded our advice and resolved the issue in commit fbb9cc9985746234dcb746666a112c7debfb7acf.

ERC-06 | COMPARISON TO BOOLEAN CONSTANT

Category	Severity	Location	Status
Coding Style	Informational	lillius(ERC-20).sol: 124, 133, 152, 171, 189, 208	Resolved

Description

Boolean constants can be used directly and do not need to be compared to true or false.

```
124        require(_stopTrade != true);
```

```
133        require(_stopTrade == true);
```

```
152        require(_stopTrade != true);
```

```
171        require(_stopTrade != true);
```

```
189        require(_stopTrade != true);
```

```
208        require(_stopTrade != true);
```

Recommendation

We recommend removing the equality to the boolean constant.

Alleviation

The team heeded our advice and resolved the issue in commit fbb9cc9985746234dcb746666a112c7debfb7acf.

ERC-07 | REDUNDANT CODES

Category	Severity	Location	Status
Coding Style	Informational	lillius(ERC-20).sol: 116	Resolved

Description

In the function `totalSupply()` , the balance for the address zero will be deducted from the `_totalSupply` . However, this token does not support transferring to address zero, and it also does not inherit the burnable feature.

Recommendation

We recommend removing redundant codes.

Alleviation

The team heeded our advice and resolved the issue in commit fbb9cc9985746234dcb746666a112c7debfb7acf.

ERC-08 | MISSING CHECKS IN APPROVEANDCALL

Category	Severity	Location	Status
Logical Issue	Informational	lillius(ERC-20).sol: 219	Resolved

Description

In the function `approveAndCall()` , the below check is missing:

```
require(_stopTrade != true);
```

Recommendation

We recommend adding the above check.

Alleviation

The team heeded our advice and resolved the issue in commit fbb9cc9985746234dcb746666a112c7debfb7acf.

OPTIMIZATIONS | LILLIUS - AUDIT

ID	Title	Category	Severity	Status
ERC-01	Variables That Could Be Declared As Immutable	Gas Optimization	Optimization	Resolved

ERC-01 | VARIABLES THAT COULD BE DECLARED AS IMMUTABLE

Category	Severity	Location	Status
Gas Optimization	Optimization	lillius(ERC-20).sol: 68, 90, 91	Resolved

Description

The linked variables assigned in the constructor can be declared as `immutable`. Immutable state variables can be assigned during contract creation but will remain constant throughout the lifetime of a deployed contract. A big advantage of immutable variables is that reading them is significantly cheaper than reading from regular state variables since they will not be stored in storage.

Recommendation

We recommend declaring these variables as immutable. Please note that the `immutable` keyword only works in Solidity version `v0.6.5` and up.

Alleviation

The team heeded our advice and resolved the issue in commit fbb9cc9985746234dcb746666a112c7debfb7acf.

APPENDIX | LILLIUS - AUDIT

Finding Categories

Categories	Description
Centralization / Privilege	Centralization / Privilege findings refer to either feature logic or implementation of components that act against the nature of decentralization, such as explicit ownership or specialized access roles in combination with a mechanism to relocate funds.
Gas Optimization	Gas Optimization findings do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.
Logical Issue	Logical Issue findings detail a fault in the logic of the linked code, such as an incorrect notion on how block.timestamp works.
Language Specific	Language Specific findings are issues that would only arise within Solidity, i.e. incorrect usage of private or delete.
Coding Style	Coding Style findings usually do not affect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

Checksum Calculation Method

The "Checksum" field in the "Audit Scope" section is calculated as the SHA-256 (Secure Hash Algorithm 2 with digest size of 256 bits) digest of the content of each file hosted in the listed source repository under the specified commit.

The result is hexadecimal encoded and is the same as the output of the Linux "sha256sum" command against the target file.

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