Ether Authority

SMART CONTRACT CODE REVIEW AND SECURITY ANALYSIS REPORT

Customer:	Ruugle Team (https://ruugle.io)
Prepared on:	20/05/2021
Platform:	Binance Smart Chain
Language:	Solidity
Audit Type:	Standard

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Project file

Name	Code Review and Security Analysis Report for Ruugle Token Smart Contract
Platform	BSC / Solidity
File	Ruugle.sol
File MD5 hash	BBF69F62175EDCF7842B2AAA665E30A4
Online Contract Code	https://bscscan.com/address/0x96e29312b4d81A9bEB23D7484799a1667EbF8750

Introduction

We were contracted by the Ruugle team to perform the Security audit of the Ruugle Token smart contract code. The audit has been performed using manual analysis as well as using automated software tools. This report presents all the findings regarding the audit performed on 20/05/2021.

The Audit type was Standard Audit. Which means this audit is concluded based on Standard audit scope, which is one security engineer performing audit procedure for 2 days. This document outlines all the findings as well as an AS-IS overview of the smart contract codes.

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Quick Stats:

Main Category	Subcategory	Result
Contract Programming	Solidity version not specified	Passed
	Solidity version too old	Moderated
	Integer overflow/underflow	Passed
	Function input parameters lack of check	Passed
	Function input parameters check bypass	Passed
	Function access control lacks management	Passed
	Critical operation lacks event log	Moderated
	Human/contract checks bypass	Passed
	Random number generation/use vulnerability	Passed
	Fallback function misuse	Passed
	Race condition	Passed
	Logical vulnerability	Passed
	Other programming issues	Passed
Code Specification	Function visibility not explicitly declared	Passed
	Var. storage location not explicitly declared	Passed
	Use keywords/functions to be deprecated	Passed
	Other code specification issues	Passed
Gas Optimization	Assert() misuse	Passed
	High consumption ‘for/while’ loop	Passed
	High consumption ‘storage’ storage	Passed
	“Out of Gas” Attack	Passed
Business Risk	The maximum limit for mintage not set	Passed
	“Short Address” Attack	Passed
	“Double Spend” Attack	Passed

Overall Audit Result: PASSED

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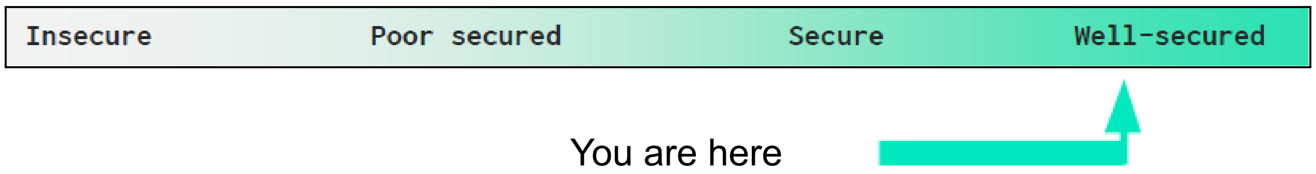
Executive Summary

According to the **standard** audit assessment, Customer`s solidity smart contract is **Well secured**.



We used various tools like Mythril, Slither and Remix IDE. At the same time this finding is based on critical analysis of the manual audit.
All issues found during automated analysis were manually reviewed and applicable vulnerabilities are presented in the Audit overview section. General overview is presented in AS-IS section and all identified issues can be found in the Audit overview section.

We found 0 critical, 0 high, 0 medium and 1 low and some very low level issues.

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Code Quality

Ruugle Token smart contract has 1 smart contract. This smart contract also contains Libraries, Smart contract inherits and Interfaces. These are compact and well written contracts.

The libraries in the Ruugle Token protocol are part of its logical algorithm. A library is a different type of smart contract that contains reusable code. Once deployed on the blockchain (only once), it is assigned a specific address and its properties / methods can be reused many times by other contracts in the Ruugle Token protocol.

The Ruugle team has **not** provided scenario and unit test scripts, which would have helped to determine the integrity of the code in an automated way.

Overall, code parts are **not well** commented on smart contracts.

Documentation

We were given Ruugle token smart contracts code in the form of a BscScan web link. The hash of that code and that web link are mentioned above in the table.

As mentioned above, most code parts are **not well** commented. so it is difficult to quickly understand the programming flow as well as complex code logic. Comments are very helpful in understanding the overall architecture of the protocol.

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Another source of information was its official website which provided rich information about the project architecture and tokenomics.

Use of Dependencies

As per our observation, the libraries are used in this smart contract infrastructure that are based on well known industry standard open source projects. And their core code blocks are written well.

Apart from libraries, its functions are not used in external smart contract calls.

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AS-IS overview

Ruugle is a BEP20 token smart contract, having features like minting, etc. Its core components are described below:

Ruugle.sol

(1) Inherited contracts

(a) Ownable: Ownership contract.

(b) ERC20: ERC20 contract.

(2) Events

(a) event Mint(uint256 _value);

(b) event Transfer(address indexed _from, address indexed _to, uint256 _value);

(c) event Approval(address indexed _owner, address indexed _spender, uint256 _value);

(3) Functions

Sl.	Functions	Type	Observation	Conclusion
1	mint	write	access by only owner	No Issue
2	balanceOf	read	Passed	No Issue
3	transfer	write	Passed	No Issue
4	transferFrom	write	Passed	No Issue
5	approve	write	Passed	No Issue
6	allowance	read	Passed	No Issue
7	changeOwner	write	access by only owner	No Issue
8	acceptOwnership	write	Passed	No Issue

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Severity Definitions

Risk Level	Description
Critical	Critical vulnerabilities are usually straightforward to exploit and can lead to tokens loss etc.
High	High-level vulnerabilities are difficult to exploit; however, they also have significant impact on smart contract execution, e.g. public access to crucial functions
Medium	Medium-level vulnerabilities are important to fix; however, they can't lead to tokens lose
Low	Low-level vulnerabilities are mostly related to outdated, unused etc. code snippets, that can't have significant impact on execution
Lowest / Code Style / Best Practice	Lowest-level vulnerabilities, code style violations and info statements can't affect smart contract execution and can be ignored.

Audit Findings

Critical

No critical severity vulnerabilities were found.

High

No High severity vulnerabilities were found.

Medium

No Medium severity vulnerabilities were found.

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Low

(1) Missing Events emitting

```
function acceptOwnership() public {
    if (msg.sender == newOwner) {
        owner = newOwner;
    }
}
```

In a decentralized world, ownership change in the contract is considered an important state change. And thus, it should emit an event. The same thing in the mint function. It is generating new tokens. But there is no Transfer event. Ideally, there should be a Transfer event which logs tokens generated from address(0) to recipient. The same thing in the constructor, there should be a Transfer event.

Resolution: This issue is acknowledged.

Very Low / Best Practices

(1) Specify explicit visibility

```
address owner;
address newOwner;
```

Although, this does not raise any security vulnerabilities. But it is best practice to specify visibility to avoid confusion.

(2) declare variables as constant

```
string public symbol;
string public name;
uint8 public decimals;
```

It is a good practice to specify variables as constant, which would not be modified. It saves some gas as well.

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(3) Approve of BEP20 standard: This can be used to front run. From the client side, only use this function to change the allowed amount to 0 or from 0 (wait till transaction is mined and approved). This should be done from the client side.

(4) All functions which are not called internally, must be declared as external. It is more efficient as sometimes it saves some gas.
https://ethereum.stackexchange.com/questions/19380/external-vs-public-best-practices

Centralization

This smart contract has some functions which can be executed by Admin (Owner) only. If the admin wallet private key would be compromised, then it would create trouble. Following are Admin functions:

- changeOwner: Owner has permission to change the owner address
- mint: Owner can mint new tokens upto the max limit of 200 million. This maximum minting limit is a good thing.

For better decentralized user experience, it's better to renounce the ownership if not needed.

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Conclusion

We were given a contract code. And we have used all possible tests based on given objects as files. We observed some issues in the smart contract and those are fixed/acknowledged in the smart contract. **So it is good to go for the production.**

Since possible test cases can be unlimited for such smart contract protocol, we provide no such guarantee of future outcomes. We have used all the latest static tools and manual observations to cover maximum possible test cases to scan everything.

Smart contracts within the scope were manually reviewed and analyzed with static analysis tools. Smart Contract's high level description of functionality was presented in As-is overview section of the report.

Audit report contains all found security vulnerabilities and other issues in the reviewed code.

Security state of the reviewed contract, based on standard audit procedure scope, is "**Well Secured**".

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Our Methodology

We like to work with a transparent process and make our reviews a collaborative effort. The goals of our security audits are to improve the quality of systems we review and aim for sufficient remediation to help protect users. The following is the methodology we use in our security audit process.

Manual Code Review:
In manually reviewing all of the code, we look for any potential issues with code logic, error handling, protocol and header parsing, cryptographic errors, and random number generators. We also watch for areas where more defensive programming could reduce the risk of future mistakes and speed up future audits. Although our primary focus is on the in-scope code, we examine dependency code and behavior when it is relevant to a particular line of investigation.

Vulnerability Analysis:
Our audit techniques included manual code analysis, user interface interaction, and whitebox penetration testing. We look at the project's web site to get a high level understanding of what functionality the software under review provides. We then meet with the developers to gain an appreciation of their vision of the software. We install and use the relevant software, exploring the user interactions and roles. While we do this, we brainstorm threat models and attack surfaces. We read design documentation, review other audit results, search for similar projects, examine source code dependencies, skim open issue tickets, and generally investigate details other than the implementation.

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Documenting Results:

We follow a conservative, transparent process for analyzing potential security vulnerabilities and seeing them through successful remediation. Whenever a potential issue is discovered, we immediately create an Issue entry for it in this document, even though we have not yet verified the feasibility and impact of the issue. This process is conservative because we document our suspicions early even if they are later shown to not represent exploitable vulnerabilities. We generally follow a process of first documenting the suspicion with unresolved questions, then confirming the issue through code analysis, live experimentation, or automated tests. Code analysis is the most tentative, and we strive to provide test code, log captures, or screenshots demonstrating our confirmation. After this we analyze the feasibility of an attack in a live system.

Suggested Solutions:

We search for immediate mitigations that live deployments can take, and finally we suggest the requirements for remediation engineering for future releases. The mitigation and remediation recommendations should be scrutinized by the developers and deployment engineers, and successful mitigation and remediation is an ongoing collaborative process after we deliver our report, and before the details are made public.

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Disclaimers

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EtherAuthority team has analyzed this smart contract in accordance with the best industry practices at the date of this report, in relation to: cybersecurity vulnerabilities and issues in smart contract source code, the details of which are disclosed in this report, (Source Code); the Source Code compilation, deployment and functionality (performing the intended functions).

Due to the fact that the total number of test cases are unlimited, the audit makes no statements or warranties on security of the code. It also cannot be considered as a sufficient assessment regarding the utility and safety of the code, bugfree status or any other statements of the contract. While we have done our best in conducting the analysis and producing this report, it is important to note that you should not rely on this report only. We also suggest conducting a bug bounty program to confirm the high level of security of this smart contract.

Technical Disclaimer

Smart contracts are deployed and executed on the blockchain platform. The platform, its programming language, and other software related to the smart contract can have their own vulnerabilities that can lead to hacks. Thus, the audit can't guarantee explicit security of the audited smart contracts.

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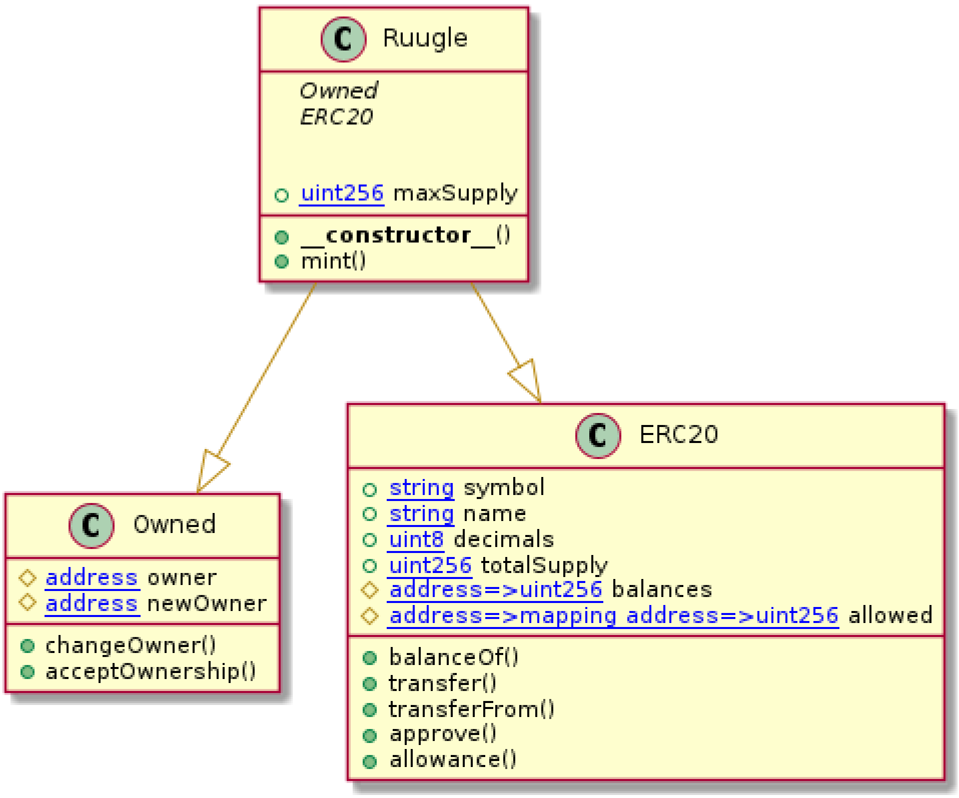
Code Flow Diagram - Ruugle Token



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Slither Results Log

```
Slither Report Ruugle.sol
root@mnb-ThinkPad-T410:/home/mnb/slitherContracts#
root@mnb-ThinkPad-T410:/home/mnb/slitherContracts# slither Ruugle.sol
INFO:Detectors:
Contract locking ether found:
Contract Ruugle (Ruugle.sol#66-91) has payable functions:
- Ruugle.receive() (Ruugle.sol#80-82)
But does not have a function to withdraw the ether
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#contracts-that-lock-ether
INFO:Detectors:
Owned.changeOwner(address)._newOwner (Ruugle.sol#16) lacks a zero-check on :
- newOwner = _newOwner (Ruugle.sol#17)
Ruugle.constructor(address)._owner (Ruugle.sol#70) lacks a zero-check on :
- owner = _owner (Ruugle.sol#76)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-zero-addressvalidation
INFO:Detectors:
Pragma version0.8.0 (Ruugle.sol#5) necessitates a version too recent to be trusted. Consider
deploying with 0.6.12/0.7.6
solc-0.8.0 is not recommended for deployment
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-versions-ofsolidity
INFO:Detectors:
Parameter Owned.changeOwner(address)._newOwner (Ruugle.sol#16) is not in mixedCase
Parameter ERC20.balanceOf(address)._owner (Ruugle.sol#36) is not in mixedCase
Parameter ERC20.transfer(address,uint256)._to (Ruugle.sol#38) is not in mixedCase
Parameter ERC20.transfer(address,uint256)._amount (Ruugle.sol#38) is not in mixedCase
Parameter ERC20.transferFrom(address,address,uint256)._from (Ruugle.sol#46) is not in
mixedCase
Parameter ERC20.transferFrom(address,address,uint256)._to (Ruugle.sol#46) is not in mixedCase
Parameter ERC20.transferFrom(address,address,uint256)._amount (Ruugle.sol#46) is not in
mixedCase
Parameter ERC20.approve(address,uint256)._spender (Ruugle.sol#55) is not in mixedCase
Parameter ERC20.approve(address,uint256)._amount (Ruugle.sol#55) is not in mixedCase
Parameter ERC20.allowance(address,address)._owner (Ruugle.sol#61) is not in mixedCase
Parameter ERC20.allowance(address,address)._spender (Ruugle.sol#61) is not in mixedCase
Parameter Ruugle.mint(uint256)._amount (Ruugle.sol#84) is not in mixedCase
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#conformance-to-soliditynaming-
conventions
INFO:Detectors:
Ruugle.constructor(address) (Ruugle.sol#70-78) uses literals with too many digits:
- totalSupply = 179000000e18 (Ruugle.sol#74)
Ruugle.constructor(address) (Ruugle.sol#70-78) uses literals with too many digits:
- maxSupply = 200000000e18 (Ruugle.sol#75)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#too-many-digits
INFO:Detectors:
changeOwner(address) should be declared external:
- Owned.changeOwner(address) (Ruugle.sol#16-18)
acceptOwnership() should be declared external:
- Owned.acceptOwnership() (Ruugle.sol#19-23)
balanceOf(address) should be declared external:
- ERC20.balanceOf(address) (Ruugle.sol#36)
transfer(address,uint256) should be declared external:
- ERC20.transfer(address,uint256) (Ruugle.sol#38-44)
transferFrom(address,address,uint256) should be declared external:
- ERC20.transferFrom(address,address,uint256) (Ruugle.sol#46-53)
approve(address,uint256) should be declared external:
- ERC20.approve(address,uint256) (Ruugle.sol#55-59)
allowance(address,address) should be declared external:
- ERC20.allowance(address,address) (Ruugle.sol#61-63)
mint(uint256) should be declared external:
- Ruugle.mint(uint256) (Ruugle.sol#84-90)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#public-function-thatcould-
be-declared-external
INFO:Slither:Ruugle.sol analyzed (3 contracts with 75 detectors), 27 result(s) found
INFO:Slither:Use https://crytic.io/ to get access to additional detectors and Github integration
root@mnb-ThinkPad-T410:/home/mnb/slitherContracts#
```

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