CERTIK

Code Security Assessment

Head Football

Jan 14th, 2022

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Summary

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

- 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.

Overview

Project Summary

Project Name	Head Football
Platform	other
Language	Solidity
Codebase	https://github.com/HeadFootball/HeadFootball/tree/8d18fce9ba55c0be3d908267c1cfc00c64e07e79
Commit	8d18fce9ba55c0be3d908267c1cfc00c64e07e79

Audit Summary

Delivery Date	Jan 14, 2022
Audit Methodology	Static Analysis, Manual Review

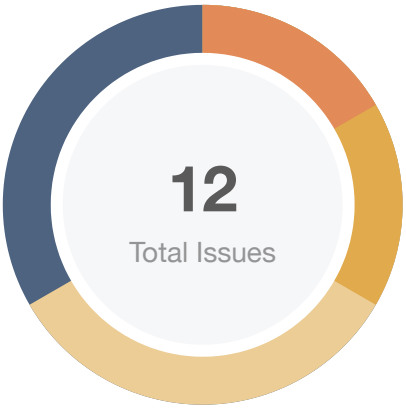
Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	0	0	0	0	0	0
Major	2	0	0	2	0	0
Medium	2	0	0	1	0	1
Minor	4	0	0	2	0	2
Informational	4	0	0	1	0	3
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
HEA	HEADFOOTBALL.SOL	35a168418a67bd23147bb05c1999687bec1aed26ba6b1775833c95279f3c724e

Findings



Critical	**0** (0.00%)
Major	**2** (16.67%)
Medium	**2** (16.67%)
Minor	**4** (33.33%)
Informational	**4** (33.33%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
GLOBAL-01	Third Party Dependencies	Volatile Code	Minor	Acknowledged
GLOBAL-02	Variable Could be Declared as `constant`	Gas Optimization	Informational	Resolved
GLOBAL-03	Missing Event Emitting	Coding Style	Informational	Acknowledged
GLOBAL-04	Centralization Related Risks	**Centralization / Privilege**	**Major**	Acknowledged
GLOBAL-05	Tokenomics	Control Flow	Medium	Acknowledged
HEA-01	Token Minted To Centralized Address	**Centralization / Privilege**	**Major**	Acknowledged
HEA-02	Incorrect Error Message	Logical Issue	Minor	Resolved
HEA-03	Updating `_uniswapV2Pair` Without Checking Existence	Volatile Code	Medium	Resolved
HEA-04	Lack of Zero Address Validation	Volatile Code	Minor	Resolved
HEA-05	Redundant Code	Logical Issue	Informational	Resolved
HEA-06	Potential Sandwich Attacks	Logical Issue	Minor	Acknowledged
HEA-07	Updating `_tOwned` Directly	Logical Issue	Informational	Resolved

GLOBAL-01 | Third Party Dependencies

Category	Severity	Location	Status
Volatile Code	Minor	Global	Acknowledged

Description

The contract is serving as the underlying entity to interact with third-party protocols. The scope of the audit treats 3rd party entities as black boxes and assumes their functional correctness. However, in the real world, 3rd parties can be compromised and this may lead to lost or stolen assets. In addition, upgrades of 3rd parties can possibly create severe impacts, such as increasing fees of 3rd parties, migrating to new LP pools, etc.

Recommendation

We understand that the business logic of this project requires interaction with the third-party `Swap` protocol. We encourage the team to constantly monitor the statuses of 3rd parties to mitigate the side effects when unexpected activities are observed.

Alleviation

The client acknowledged.

GLOBAL-02 | Variable Could be Declared as `constant`

Category	Severity	Location	Status
Gas Optimization	Informational	Global	Resolved

Description

Variables `_tTotal`, `_name`, `_symbol` and `_decimals` could be declared as `constant` since these state variables are never to be changed.

Recommendation

We recommend declaring those variables as `constant`.

Alleviation

The team heeded our advice and changed related codes. Code change was applied in commit 2bc183d1fb7e411942880aa53f54b90c58ab4537.

GLOBAL-03 | Missing Event Emitting

Category	Severity	Location	Status
Coding Style	Informational	Global	Acknowledged

Description

In the contract `HeadFootBall`, there are a bunch of functions can change state variables. However, these function do not emit event to pass the changes out of chain.

Recommendation

Recommend emitting events, for all the essential state variables that are possible to be changed during runtime.

Alleviation

The client acknowledged.

GLOBAL-04 | Centralization Related Risks

Category	Severity	Location	Status
Centralization / Privilege	Major	Global	Acknowledged

Description

In the contract `HeadFootBall`, the role `owner` has the authority over the following function:

- excludeFromReward()
- includeInReward()
- excludeFromFee()
- includeInFee()
- setTaxFeePercent()
- setMarketingFeePercent()
- setMinNumTokensSellToGetBnb()
- updateRouter()
- setMaxTxAmount()
- setSwapAndLiquifyEnabled()
- setMarketingWallet()
- claimStuckTokens()

In the contract `Ownable`, the role `owner` has the authority over the following function:

- renounceOwnership()
- transferOwnership()

Additionally, `_marketingWallet` will be used to receive `BNB`.

Any compromise to these accounts may allow the hacker to manipulate the project through these functions.

Recommendation

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., multi-signature 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.

Alleviation

The client acknowledged.

GLOBAL-05 | Tokenomics

Category	Severity	Location	Status
Control Flow	Medium	Global	Acknowledged

Description

The HeadFootBall Protocol is a decentralized finance (DeFi) token. Each HeadFootBall transaction is taxed taxFee/MarketingFee fees totalling 6% of the transaction amount. The first fee is redistributed to all existing holders using a form of rebasing mechanism whilst the other 4% is accumulated internally until a sufficient amount of capital has been amassed to perform a swap. When this number is reached, the total tokens accumulated will be converted to BNB and transferred to a `_marketingWallet`. The owner can updated the fee rates at any time.

Recommendation

We recommend to publish this feature to the community.

Alleviation

The client acknowledged.

HEA-01 | Token Minted To Centralized Address

Category	Severity	Location	Status
Centralization / Privilege	**Major**	HEADFOOTBALL.SOL: 858~859	Acknowledged

Description

The total supply amount of tokens that are minted to the centralized address `_msgSender()` who is `owner`, may raise the community's concerns about the centralization issue.

Recommendation

We advise the client to carefully manage the `owner` account's private key and avoid any potential risks of being hacked. We also advise the client to adopt Multisig, Timelock, and/or DAO in the project to manage this specific account in this case.

Alleviation

The client acknowledged.

HEA-02 | Incorrect Error Message

Category	Severity	Location	Status
Logical Issue	Minor	HEADFOOTBALL.SOL: 977	Resolved

Description

The error message in `require(_isExcluded[account], "Account is already excluded")` does not describe the error correctly.

Recommendation

The message "Account is already excluded" can be changed to "Account is not excluded" .

Alleviation

The team heeded our advice and changed related codes. Code change was applied in commit 2bc183d1fb7e411942880aa53f54b90c58ab4537.

HEA-03 | Updating `_uniswapV2Pair` Without Checking Existence

Category	Severity	Location	Status
Volatile Code	Medium	HEADFOOTBALL.SOL: 1013~1020	Resolved

Description

In function `updateRouter()`, new pair is created without checking existence. If the new pair is already created, `IUniswapV2Factory` will revert the transaction. As a result, the new router will never be set successfully.

Recommendation

We recommend the client to change as below:

```
function updateRouter(address newAddress) external onlyOwner {
    require(newAddress != address(uniswapV2Router), "TOKEN: The router already has that
address");
    uniswapV2Router = IUniswapV2Router02(newAddress);
    address get_pair =
IUniswapV2Factory(uniswapV2Router.factory()).getPair(address(this),
uniswapV2Router.WETH());
    if (get_pair == address(0)) {
        uniswapV2Pair =
IUniswapV2Factory(uniswapV2Router.factory()).createPair(address(this),
uniswapV2Router.WETH());
    } else {
        uniswapV2Pair = get_pair;
    }
}
```

Alleviation

The team heeded our advice and changed related codes. Code change was applied in commit 2bc183d1fb7e411942880aa53f54b90c58ab4537.

HEA-04 | Lack of Zero Address Validation

Category	Severity	Location	Status
Volatile Code	Minor	HEADFOOTBALL.SOL: 1030	Resolved

Description

The `_marketingWallet` lacks of zero address validation.

Recommendation

We advise the client to add an input validation in `setMarketingWallet()` as follows.

```
require(marketingWallet != address(0), "marketingWallet address can not be zero!");
```

Alleviation

The team heeded our advice and changed related codes. Code change was applied in commit 2bc183d1fb7e411942880aa53f54b90c58ab4537.

HEA-05 | Redundant Code

Category	Severity	Location	Status
Logical Issue	Informational	HEADFOOTBALL.SOL: 1224~1225	Resolved

Description

The condition `!_isExcluded[sender] && !_isExcluded[recipient]` can be included in `else` .

Recommendation

The following code can be removed:

```
... else if (!_isExcluded[sender] && !_isExcluded[recipient]) {
        _transferStandard(sender, recipient, amount);
    } ...
```

Alleviation

The team heeded our advice and changed related codes. Code change was applied in commit 2bc183d1fb7e411942880aa53f54b90c58ab4537.

HEA-06 | Potential Sandwich Attacks

Category	Severity	Location	Status
Logical Issue	Minor	HEADFOOTBALL.SOL: 1203~1204	Acknowledged

Description

A sandwich attack might happen when an attacker observes a transaction swapping tokens or adding liquidity without setting restrictions on slippage or minimum output amount. The attacker can manipulate the exchange rate by frontrunning (before the transaction being attacked) a transaction to purchase one of the assets and make profits by backrunning (after the transaction being attacked) a transaction to sell the asset.

The following functions are called without setting restrictions on slippage or minimum output amount, so transactions triggering these functions are vulnerable to sandwich attacks, especially when the input amount is large:

- `uniswapV2Router.swapExactTokensForETHSupportingFeeOnTransferTokens()`

Recommendation

We recommend setting reasonable minimum output amounts, instead of 0, based on token prices when calling the aforementioned functions.

Alleviation

The client acknowledged.

HEA-07 | Updating `_tOwned` Directly

Category	Severity	Location	Status
Logical Issue	Informational	HEADFOOTBALL.SOL: 1098	Resolved

Description

The function `_takeMarketing()` updates `_tOwned[address(this)]` without checking whether `address(this)` is excluded from reward or not.

Recommendation

We recommend the client to update `_tOwned[address(this)]` only when `address(this)` is excluded from reward.

Alleviation

The team heeded our advice and changed related codes. Code change was applied in commit 2bc183d1fb7e411942880aa53f54b90c58ab4537.

Appendix

Finding Categories

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.

Control Flow

Control Flow findings concern the access control imposed on functions, such as owner-only functions being invoke-able by anyone under certain circumstances.

Volatile Code

Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases that may result in a vulnerability.

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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