Cyberscope

Audit Report

Avatar

January 2023

Network Matic

Address 0xc7728354f9fe0e43514b1227162d5b0e40fad410

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Review

Contract Name	Avatar
Compiler Version	v0.8.14+commit.80d49f37
Optimization	1000000 runs
Explorer	https://polygonscan.com/address/0xc7728354f9fe0e43514b1227162d5b0e40fad410
Address	0xc7728354f9fe0e43514b1227162d5b0e40fad410
Network	MATIC

Audit Updates

Initial Audit	03 Feb 2023
Corrected Phase 2	07 Feb 2023

Source Files

Filename	SHA256
Avatar.sol	be2054bd5885b5f9ea92d09a8e0aa9ef9309c465eee512e81aba8a40ca32d000
Bucket.sol	d44fad02536763eb73fe5851557b6ca72170ed68abd2c0dfd5f4ce9e8de9bdea
PaymentSplitter.sol	3d6f05b7f58486efc348b9e636c1431b7cb7250aa4362ddbec8822589df52cb6

Diagnostics

Critical Medium Minor / Informative

Severity	Code	Description	Status
●	PMV	Potential Misleading Value	Resolved
●	RV	Randomization Vulnerability	Acknowledged
●	DTM	Data Type Misuse	Acknowledged
●	L04	Conformance to Solidity Naming Conventions	Acknowledged
●	L14	Uninitialized Variables in Local Scope	Acknowledged

PMV - Potential Misleading Value

Criticality	Minor / Informative
Location	Bucket.sol#L103
Status	Resolved

Description

The contract is utilizing a binary search in order to achieve `O(log n)` time complexity in the search of the ordered array. If the value is matched, then the index of the array is returned. The return value is cast to `uint16`. That means if the array length is more than `2^16` then the function will yield misleading values.

```
function binarySearch(uint16[] storage array, uint16 target) internal view
returns (uint16) {
    ...
    if (target < array[left]) {
        return uint16(left);
    } else {
        return uint16(right);
    }
}
```

Recommendation

The team is advised to implement a `require()` check in the length of the array so it will guarantee that the binary search algorithm will always yield the correct values.

Team Update

"Thank you for the thorough review. To clarify, we will only set the stock once for each ledgerType prior to the start of the game. We are confident that the array size is less than 2e16. However, to be more cautious, we have added a security check `"require(stockPrefixSum.length <= 2e16, "stock length too long");"` in our `_setStock` function."

RV - Randomization Vulnerability

Criticality	Minor / Informative
Location	Bucket.sol#L79
Status	Acknowledged

Description

The contract is using an on-chain technique in order to determine random numbers. The blockchain runtime environment is fully deterministic, as a result, the pseudo-random numbers could be predicted.

```
function _getRandomIndex(uint256 seed, uint16 size) internal view returns
(uint16) {
    keccak256(
        abi.encodePacked(
            block.difficulty,
            block.timestamp,
            ...
        )
    )
}
```

Recommendation

The contract could use an advanced randomization technique that guarantees an acceptable randomization factor. For instance, the Chainlink VRF (Verifiable Random Function). https://docs.chain.link/docs/chainlink-vrf

Team Update

"We have decided to proceed with this approach in order to simplify the open position process and reduce the complexity of the overall project. As mentioned in the comments, we do not prevent Polygon validators from adjusting the block.timestamp in order to predict the date. The timestamp is a difficult value to predict for normal users, compared to block.number. Nonetheless, thank you for the suggestion."

DTM - Data Type Misuse

Criticality	Minor / Informative
Status	Acknowledged

Description

The contract is using the `ledgerType` an enumerated integer. It accept values between 0 and 6. The `ledgerType` data type is `uint256`. Since it will always be less than 6, then the 2^256 data type necessary reserves space.

```
require(ledgerType < 6, "Invalid ledger type");
```

Recommendation

The team is advised to use the minimum data type that can model a maximum of 6 integer variable. A suggested implementation could be to utilize an `uint8` data type.

Team Update

"We really appreciate your suggestion; it truly saved storage costs when we could pack the variable or call data. However, almost all function parameters throughout the whole contract, there are no cases where we can pack uint8 with other variables that are full 256 size. Therefore, there is no significant benefit in our project, especially when doing comparisons, as it might cost extra gas for doing implicit conversion between uint8 and uint256. Therefore, we decided not to modify the data types for ledgerType. Thank you."

L04 - Conformance to Solidity Naming Conventions

Criticality	Minor / Informative
Location	Avatar.sol#L23,206,218
Status	Acknowledged

Description

The Solidity style guide is a set of guidelines for writing clean and consistent Solidity code. Adhering to a style guide can help improve the readability and maintainability of the Solidity code, making it easier for others to understand and work with.

The followings are a few key points from the Solidity style guide:

1. Use camelCase for function and variable names, with the first letter in lowercase (e.g., myVariable, updateCounter).
2. Use PascalCase for contract, struct, and enum names, with the first letter in uppercase (e.g., MyContract, UserStruct, ErrorEnum).
3. Use uppercase for constant variables and enums (e.g., MAX_VALUE, ERROR_CODE).
4. Use indentation to improve readability and structure.
5. Use spaces between operators and after commas.
6. Use comments to explain the purpose and behavior of the code.
7. Keep lines short (around 120 characters) to improve readability.

```
uint256[6] public DEFAULT_TARGET_AMOUNTS = [13e22, 25e22, 35e22, 50e22,
75e22, 125e22]
bool _paused
address _operator
```

Recommendation

By following the Solidity naming convention guidelines, the codebase increased the readability, maintainability, and makes it easier to work with.

Find more information on the Solidity documentation
https://docs.soliditylang.org/en/v0.8.17/style-guide.html#naming-convention.

Team Update

"Thank you for the formatting suggestion, but as our front-end and automated tests are already based on the current variable naming style, and it does not affect any business logic or security, we decide not to make changes in the new version. However, we will keep this in mind for future projects."

L14 - Uninitialized Variables in Local Scope

Criticality	Minor / Informative
Location	Avatar.sol#L741,1005
Status	Unresolved

Description

Using an uninitialized local variable can lead to unpredictable behavior and potentially cause errors in the contract. It's important to always initialize local variables with appropriate values before using them.

```
uint256 payoutAmount
ReferrerSearch memory search
```

Recommendation

By initializing local variables before using them, the contract ensures that the functions behave as expected and avoid potential issues.

Team Update

"Thank you for bringing this up. All variables that are not initialized should default to zero in our business logic design. Based on the current official documentation, we believe that variables in memory are always initialized to zero. Reference: crytic/slither: Issue #782"

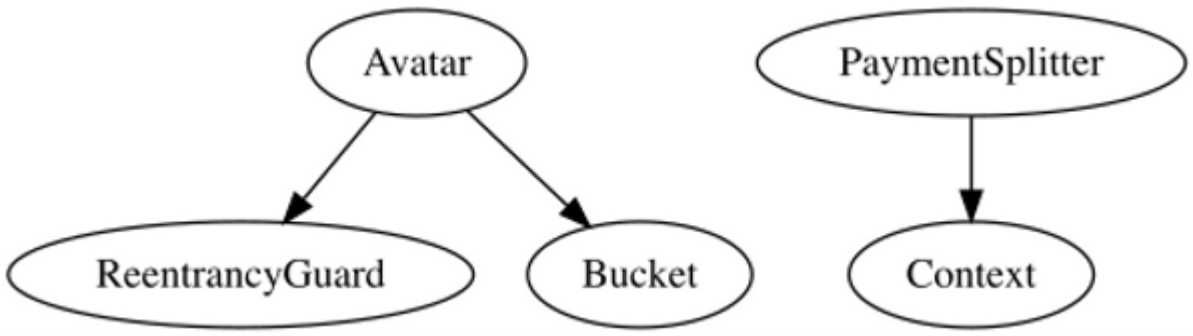
Functions Analysis

Contract	Type	Bases		
	Function Name	**Visibility**	**Mutability**	**Modifiers**
Avatar	Implementation	Reentrancy Guard, Bucket		
		Public	✓	-
	setPause	External	✓	-
	transferOperator	External	✓	-
	dropTempAdmin	External	✓	-
	batchSetReferrerInfo	External	✓	-
	setStock	External	✓	-
	openPosition	External	Payable	notContract nonReentrant
	closePosition	External	✓	notContract nonReentrant
	batchClosePositions	External	✓	nonReentrant
	batchClaimPositionIncentiveReward	External	✓	notContract nonReentrant
	batchReportSales	External	✓	-
	claimReferrerReward	External	✓	notContract nonReentrant
	getLinkedPositionInfo	External		-
	getUserRounds	External		-
	getUserRoundsLength	External		-
	getUserRoundLedgers	External		-
	getUserRoundLedgersLength	External		-
	getChildren	External		-
	getLedgerRoundToUserRoundIndex	External		-
	getChildrenLength	External		-

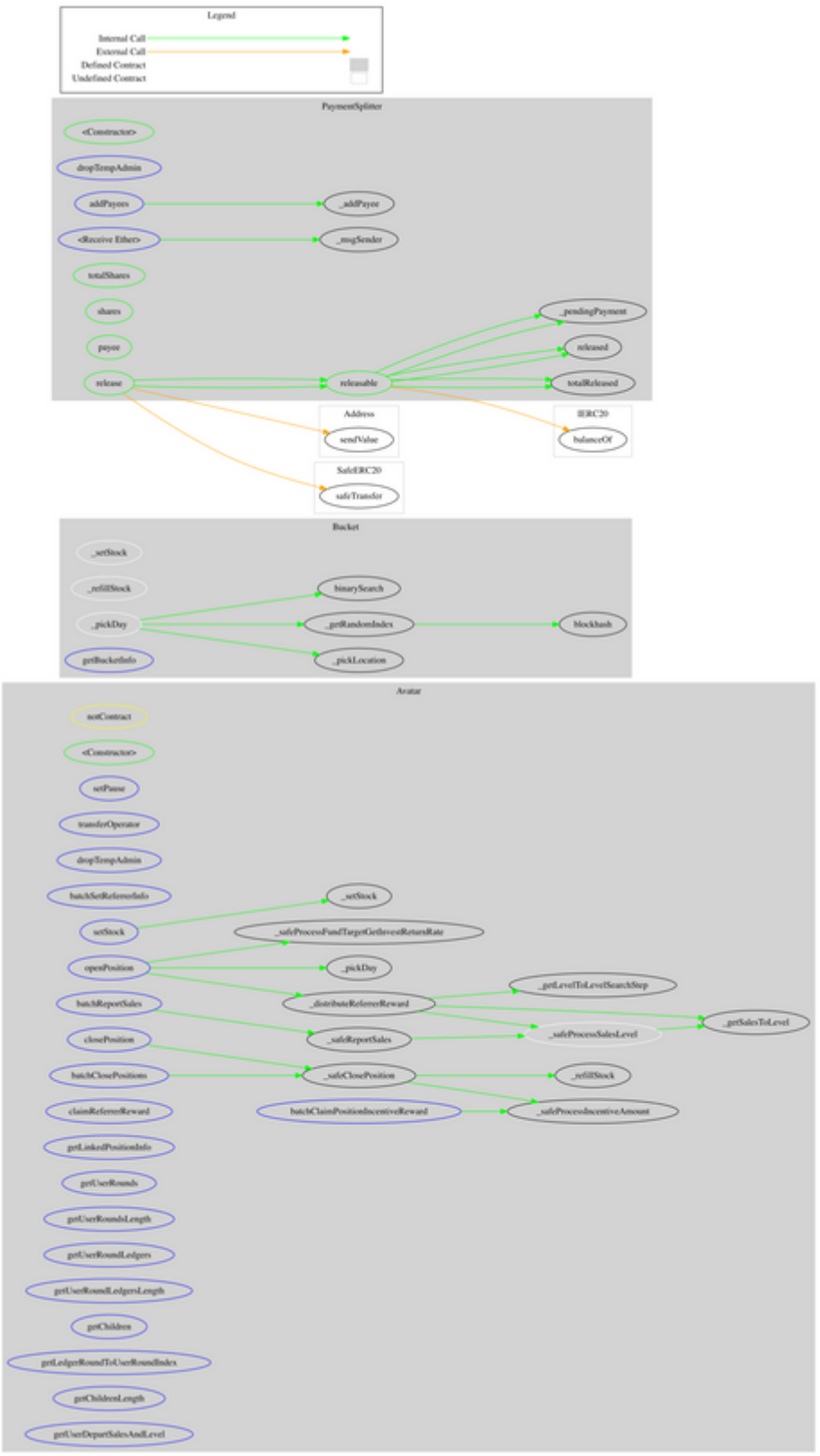
	getUserDepartSalesAndLevel	External		-
	_safeClosePosition	Internal	✓	
	_safeProcessFundTargetGetInvestReturnRate	Internal	✓	
	_safeProcessIncentiveAmount	Internal	✓	
	_safeProcessSalesLevel	Internal	✓	
	_safeReportSales	Internal	✓	
	_distributeReferrerReward	Internal	✓	
	_getSalesToLevel	Internal		
	_getLevelToLevelSearchStep	Internal		
Bucket	Implementation			
	_setStock	Internal	✓	
	_refillStock	Internal	✓	
	_pickDay	Internal	✓	
	_pickLocation	Internal	✓	
	_getRandomIndex	Internal		
	getBucketInfo	External		-
	binarySearch	Internal		
PaymentSplitter	Implementation	Context		
		Public	Payable	-
	dropTempAdmin	External	✓	-
	addPayees	External	✓	-
		External	Payable	-
	totalShares	Public		-
	totalReleased	Public		-
	totalReleased	Public		-
	shares	Public		-
	released	Public		-

	released	Public		-
	payee	Public		-
	releasable	Public		-
	releasable	Public		-
	release	Public	✓	-
	release	Public	✓	-
	_pendingPayment	Private		
	_addPayee	Private	✓	

Inheritance Graph



Flow Graph


Legend
Internal Call
External Call
Defined Contract
Undefined Contract
PaymentSplitter
<Constructor>
dropTempAdmin
addPayees
_addPayee
<Receive Ether>
_msgSender
totalShares
shares
payee
release
releasable
_pendingPayment
released
totalReleased
Address
sendValue
IERC20
balanceOf
SafeERC20
safeTransfer
Bucket
_setStock
_refillStock
_pickDay
getBucketInfo
binarySearch
_getRandomIndex
blockhash
_pickLocation
Avatar
notContract
<Constructor>
setPause
transferOperator
dropTempAdmin
batchSetRefererInfo
setStock
openPosition
batchReportSales
closePosition
batchClosePositions
claimRefererReward
getLinkedPositionInfo
getUserRounds
getUserRoundsLength
getUserRoundLedgers
getUserRoundLedgersLength
getChildren
getLedgerRoundToUserRoundIndex
getChildrenLength
getUserDepartSalesAndLevel
_setStock
_safeProcessFundTargetGetInvestReturnRate
_pickDay
_distributeRefererReward
_safeReportSales
_safeClosePosition
batchClaimPositionIncentiveReward
_getLevelToLevelSearchStep
_safeProcessSalesLevel
_getSalesToLevel
_refillStock
_safeProcessIncentiveAmount

Summary

Avatar a5 contract implements a financial mechanism. This audit investigates security issues, business logic concerns, and potential improvements.

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The Cyberscope team

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