PopBlocks Trashbin.sol Review

Nov 9, 2022

Revision: Nov 28, 2022

Table of Contents

Table of Contents **2**

Disclaimer **3**

Introduction **4**

Definitions 4

Summary 4

Review Details 4

Addressed Issues Overview 4

Review Checklist 5

Review **6**

1. Smart Contract Description 6
2. Business Requirements Review 6
3. Standards and Best Practice Review 8
4. Exaggerated Owner Rights 9
5. Potential Exploits 10
6. Recommendations 11

Conclusion **12**

Appendix 1 **13**

7. Second revision comments 13

Disclaimer

Introduction

Definitions

✅ - Statement was checked and passed the review.
❗ - Major issue that needs to be addressed.
⚠️ - Medium issue that requires attention of the developer(s).
ℹ️ - Recommendation

Summary

The purpose of this review was to achieve the following:

1. Identify potential security issues with the TrashBin smart contract.
2. Formally check the logic behind the given TrashBin smart contract.

Review Details

Time of Review	7 Nov 2022 - 9 Nov 2022
Contract Name	TrashBin.sol
MD5 Contract Sum	4b49444826e5def6e7220a10319ffa7d
MD5 Second Revision Contract Sum	d4b5a18a2c7c92d525f0f3e09cf57173

Addressed Issues Overview

Type	**Count**	**Unsolved Count**
❗ Major Issue	3	0
⚠️ Medium Issue	10	2 *(3.2, 4.2)*
ℹ️ Recommendation	3	0

Review Checklist

- Business logic overview
- Exaggerated owner permissions
- Setters allow values that could break business logic
- Gas optimisation
  - Unnecessary reads from storage
  - External calls to itself
- Maths
  - Division before multiplication
- Spelling
- 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 and other standards violation

Review

1. Smart Contract Description

The TrashBin smart contract aims to facilitate writing off losses on NFT investments by providing a guaranteed purchase of NFT tokens for a low price.

2. Business Requirements Review

TrashBin Sell Logic

2.1 ✅ An ERC721 token can be sold using ***TrashBin.sell()*** for ***100 Mgwei***

2.2 ✅ An ERC1155 token can be sold using ***TrashBin.sell()*** for ***100 Mgwei***

2.3 ✅ Multiple ERC721 tokens can be sold using ***TrashBin.sell()*** for ***100 Mgwei * amountOfTokens***

2.3 ✅ Multiple ERC1155 collections can be sold using ***TrashBin.sell()*** for ***100 Mgwei * amountOfERC1155CollectionIds***

⚠️ **[SOLVED]**The implicit ignorance of the the ERC1155 collection token amounts (e.g. ERC1155 collection id 1 with 500 value) can confuse users. Users could expect to receive ***500 * 100 Mgwei*** but will only receive ***100 Mgwei*** . This could lead to complaints.

⚠️ **[SOLVED]** A savvy user can split the amounts of an ERC1155 collection and thus achieve receiving ***100Mgwei * splitCount***. A decision needs to be made on whether payouts should be exercised based on unique contract addresses or not. (see also point 2.6). Example: ***TrashBin.sell([0x1, 0x1, ..., 0x1], [1, 1, ..., 1], [1, 1, ..., 1], [true, ...]);***

TrashBin Transfer Logic

2.4 ✅ Transferring one ERC721 token to TrashBin will transfer the sender ***100 Mgwei***

2.5 ✅ Transferring one ERC1155 collection with any amount greater than 1 will transfer sender ***100 Mgwei*** .

⚠️ **[SOLVED]** The implicit ignorance of the the ERC1155 collection token amounts (e.g. ERC1155 collection id 1 with 500 value) can confuse users. Users could expect to receive 500 * 100 Mgwei but will only receive 100 Mgwei . This could lead to complaints.

2.6 ❗ **[SOLVED]** Transferring multiple ERC1155 collections with any amount greater than 1 will transfer the sender **100 Mgwei * amountOfERC1155CollectionIds** which does not comply with the sell business logic.

Method with issue: ***onERC1155BatchReceived***

- https://github.com/CookedCookee/FragmentsDAO/blob/master/contracts/hashes_collections/trashbin/TrashBin.sol#L587

Line issue: ***(bool success,) = (from).call{value: sellPrice}("");***

- https://github.com/CookedCookee/FragmentsDAO/blob/master/contracts/hashes_collections/trashbin/TrashBin.sol#L610

Suggested remedy:

- Multiply the sellPrice by the amount of ERC1155 collection ids (or unique ones, see 2.3).

TrashBin Buy Logic

2.7 ✅ Buying one ERC721 token by paying ***0.02 ETH***

2.8 ✅ Buying multiple ERC721 tokens by paying ***0.02 ETH * amountOfTokens***

2.9 ✅ Buying one ERC1155 collection token by paying ***0.02 ETH***

2.10 ✅ Buying multiple ERC1155 collection tokens by paying ***0.02 ETH * amountOfTokens***

2.11 ✅ Buying multiple various ERC721 and ERC1155 tokens by paying ***0.02 ETH * amountOfTokens***

2.12 ✅ Applying discount prices for hashDAO token owners and hasDAO governance token owners.

3. Standards and Best Practice Review

3.1 ⚠️**[SOLVED]** Owner and HashDAO protected methods are not emitting events and thus affect transparency.

Example of methods with issue:

- ***withdrawETH***
- ***removeNFT***
- ***withdrawERC721***
- ***withdrawERC1155***
- ***withdrawERC20***
- ***deleteIndex***
- ***updateAllSettings***
- ***_updateBuyPrice***
- ***_updateSellPrice***
- ***_updateStandardHashDiscount***
- ***_updateDaoHashDiscount***
- ***_updateBuyableDelay***
- ***_updateMinEthBalance***
- ***_updateEthPercentage***

Suggested Remedy:

- Add corresponding events to the above mentioned methods.

3.2 ⚠️ **[UNSOLVED]** Not using the latest solidity compiler version, currently ***pragma solidity ^0.8.6***.

Suggested Remedy:

- Use latest solidity version ***v0.8.17***

3.3 ⚠️ **[SOLVED]** ***isNFTAvailableToBuy*** does not check if index is not out of bounds and reverts with panic code 50.

Suggested Remedy:

- Add a dedicated revert reason for index out bounds, such as to inform the user that an invalid index was used.

3.4 ⚠️ **[SOLVED]** Following methods allow looping through unlimited iterations over array elements.

While very low risk this could potentially expose the contract to DoS attacks to block other users from buying a valuable NFT until the buyableDelay is reached. Thus allowing the attacker to buy the NFT.

Reference:
https://consensys.github.io/smart-contract-best-practices/attacks/denial-of-service/#gas-limit-dos-on-the-network-via-block-stuffing

Affected methods:

- ***buy*** **[SOLVED]**
- ***sell*** **[SOLVED]**
- ***onERC1155BatchReceived*** **[SOLVED]**

Suggested Remedy:

- Define a limit for the passed array sizes and/or set a gas limit for the loops (msg.gas)

3.5 ⚠️ **[SOLVED]** Multiple reads from storage that impact gas.

Suggested Remedy:

- ***withdrawETH*** - ***address(this).balance*** is called twice. Consider saving the balance into a variable and reusing it.

4. Exaggerated Owner Rights

4.1 ⚠️ **[SOLVED]** Arbitrary value can be set on the contract settings.

Affected Methods:

- ***_updateBuyPrice*** **[SOLVED]**
- ***_updateSellPrice*** **[SOLVED]**
- ***_updateBuyableDelay*** **[SOLVED]**
- ***_updateMinEthBalance -*** **[SOLVED]** ***allows setting 100% discounts.***
- ***_updateStandardHashDiscount -*** **[SOLVED]** ***allows setting 100% discounts.***
- ***_updateDaoHashDiscount -*** **[SOLVED]** ***allows setting 100% discounts.***
- ***_updateEthPercentage -*** **[SOLVED]** ***allows setting 100% discounts. Setting it to 0 will break the withdrawETH method.***

Suggested remedy:

- Add require statements that checks for publicly visible and ideally immutable minimum and maximum values.

4.2 ⚠️ **[UNSOLVED] _*updateBuyableDelay*** will affect all previously sold NFT tokens immediately.

Scenario:

1. ***buyableDelay*** set to ***2000 blocks***
2. User sells token at block ***1000***
3. User expects the token not to be buyable for ***2000 blocks***.
4. ***TrashBin owner*** sets new ***buyableDelay*** to ***10 blocks***
5. NFT token is available for purchase.

Suggested remedy:

- Compute and set buyableDelays per NFT token.
- Restrict min and max buyableDelay for contract owner (see 4.2)

5. Potential Exploits

5.1 ❗ **[SOLVED]** Flooding the TrashBin contract with impostor ERC1155 and ERC721 tokens and thus degrading the usability of the TrashBin token buyers. This exploit becomes more feasible if the contract is deployed on a chain with low gas prices (e.g. Polygon, BSC).

Exploit PoC Code:

https://github.com/CookedCookee/FragmentsDAO/blob/poc-exploit-impostor-nft/contracts/hashes_collections/trashbin/ImpostorERC721.sol

Scenario:

1. Exploiter creates and deploys a smart contract that mimics an ERC721 and ERC1155 contract.
2. Exploiter is able to sell fake NFT tokens to the TrashBin through the following methods:
    1. ***sell***
    2. ***onERC721Received***
    3. ***onERC1155Received***
    4. ***onERC1155BatchReceived***
3. With the bootstrapped PoC by PopBlocks, the exploiter will spend more on gas than the amount received for the sold NFT tokens.
4. These fake NFT tokens sold to the TrashBin contract cannot be purchased back by users via the buy method.
5. The TrashBin owner will have to incur gas fees and time to clean up the ***nftStorage.***

Suggested Remedy:

- The reviewer was not able to identify a viable mechanism that could exclude this exploit.

- An idea could be creating and maintaining a whitelist of sellable NFT contract addresses, though this directly affects the initial value proposition of the business requirements.

5.2 ❗ **[SOLVED]** Increasing the ***sellPrice*** and the ***ETH balance*** of the ***TrashBin*** contract can justify exploiters to develop highly gas efficient exploits similar to the one in 5.1 in order to drain the contract of funds by mimicking the sale of NFT tokens.

Suggested Remedy:

- Set limits on the ***sellPrice*** setter (see 4.1)
- Further research on gas efficient exploits that can mimic the sale of fake NFTs.

6. Recommendations

6.1 ℹ️**[SOLVED]** Implement pause, unpause mechanism.

Description:

While the pause effect can be achieved by withdrawing all the ETH it would be more elegant to have a paused flag and revert reason for pausing the contract for any reason.

https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/security/Pausable.sol

6.2 ℹ️ **[SOLVED]** Consider renaming ***ethPercentage*** variable to a name reflecting that this holds the basis point fee that is transferred to the multi-sig owner.

6.3 ℹ️**[SOLVED]** Spelling and grammar mistakes were found.

- sold so to
- recieve
- precentage
- NFTs that has been sold
- becuase

Conclusion

The TrashBin contract aims to solve a viable problem, however its users would be required to investigate the code or documentation in order to understand how they will be remunerated for the tokens they sell to it (see 2.5).

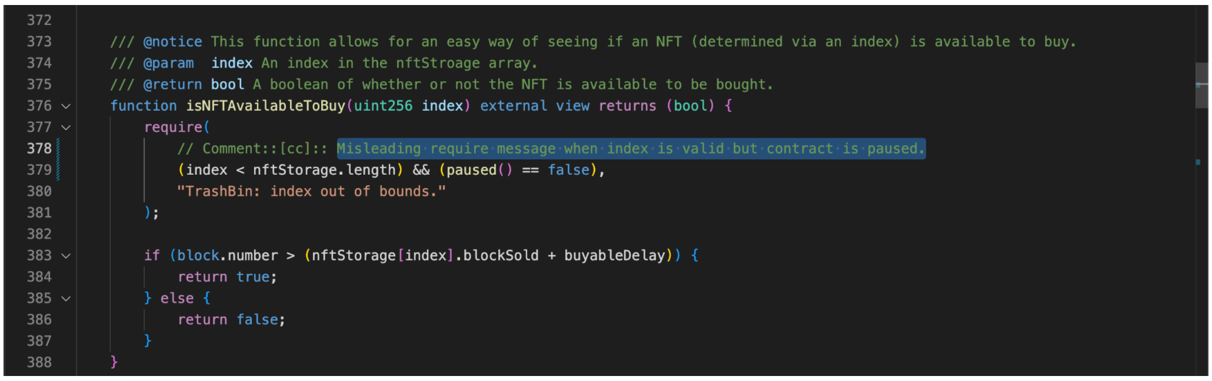
The TrashBin contract is exposed to the risk of being flooded with impostor NFTs that can degrade the usability of the contract and require maintenance. This exploit also has the risk of becoming a fund security risk. Should the sellPrice be set to a value high enough to facilitate highly efficient faking of ERC721 and ERC1155 transfers, the contract could be drained of funds.

It is highly recommended to review the suggested remedies and expand the unit tests to cover their implementation.

Appendix 1

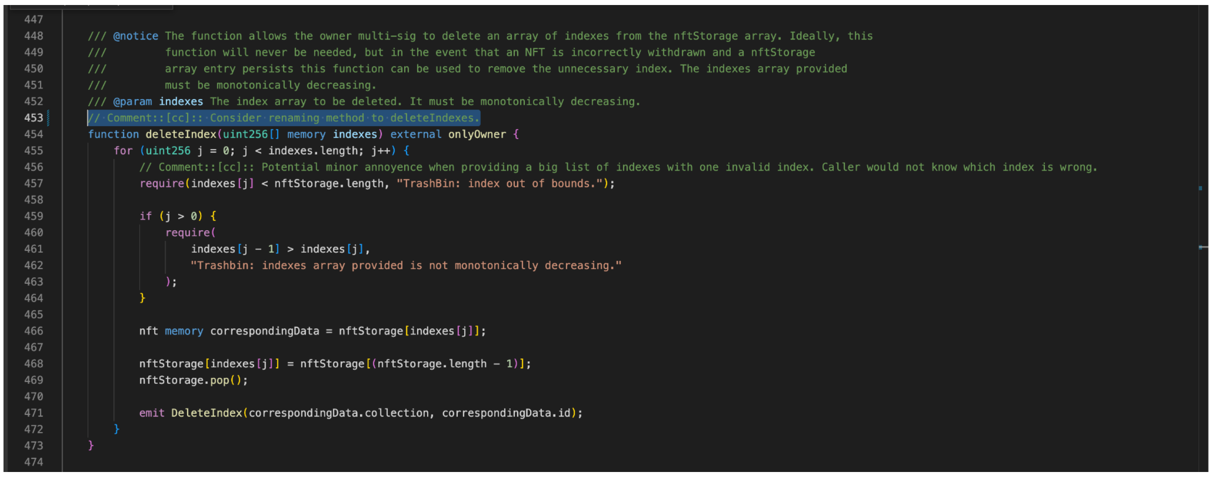
7. Second revision comments

7.1 Misleading “require” message when index is valid but contract is paused.



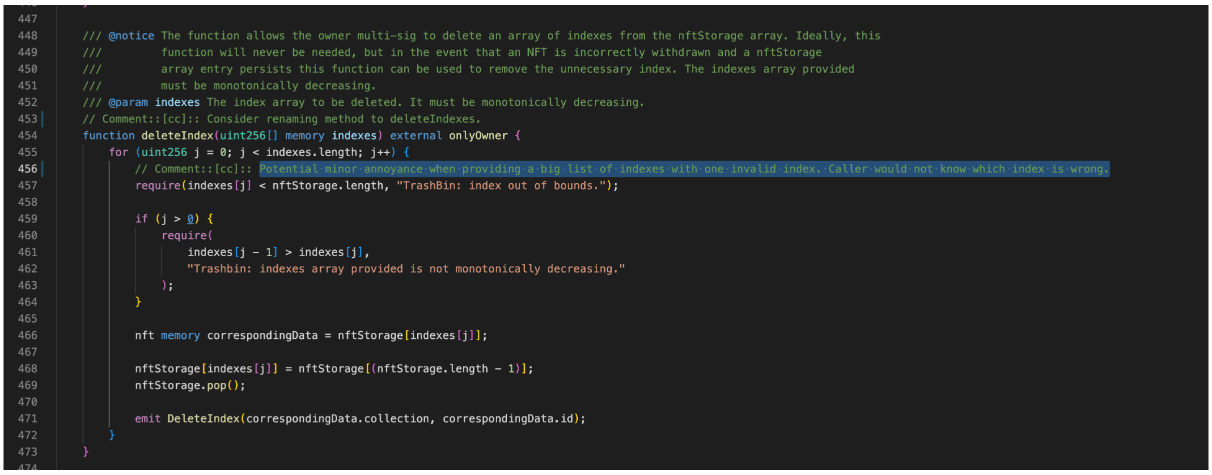
```
/// @notice This function allows for an easy way of seeing if an NFT (determined via an index) is available to buy.
/// @param  index An index in the nftStroage array.
/// @return bool A boolean of whether or not the NFT is available to be bought.
function isNFTAvailableToBuy(uint256 index) external view returns (bool) {
    require(
        // Comment::[cc]:: Misleading require message when index is valid but contract is paused.
        (index < nftStorage.length) && (paused() == false),
        "TrashBin: index out of bounds."
    );

    if (block.number > (nftStorage[index].blockSold + buyableDelay)) {
        return true;
    } else {
        return false;
    }
}
```

7.2 Consider renaming method to deleteIndexes.



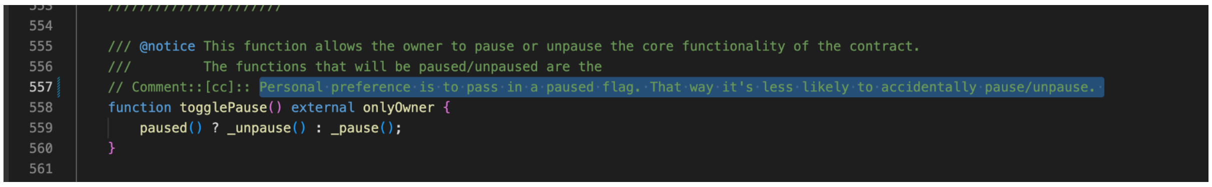
```
/// @notice The function allows the owner multi-sig to delete an array of indexes from the nftStorage array. Ideally, this
///         function will never be needed, but in the event that an NFT is incorrectly withdrawn and a nftStorage
///         array entry persists this function can be used to remove the unnecessary index. The indexes array provided
///         must be monotonically decreasing.
/// @param indexes The index array to be deleted. It must be monotonically decreasing.
// Comment::[cc]:: Consider renaming method to deleteIndexes.
function deleteIndex(uint256[] memory indexes) external onlyOwner {
    for (uint256 j = 0; j < indexes.length; j++) {
        // Comment::[cc]:: Potential minor annoyence when providing a big list of indexes with one invalid index. Caller would not know which index is wrong.
        require(indexes[j] < nftStorage.length, "TrashBin: index out of bounds.");

        if (j > 0) {
            require(
                indexes[j - 1] > indexes[j],
                "Trashbin: indexes array provided is not monotonically decreasing."
            );
        }

        nft memory correspondingData = nftStorage[indexes[j]];

        nftStorage[indexes[j]] = nftStorage[(nftStorage.length - 1)];
        nftStorage.pop();

        emit DeleteIndex(correspondingData.collection, correspondingData.id);
    }
}
```

7.3 Potential minor annoyance when providing a big list of indexes with one invalid index. Caller would not know which index is wrong.



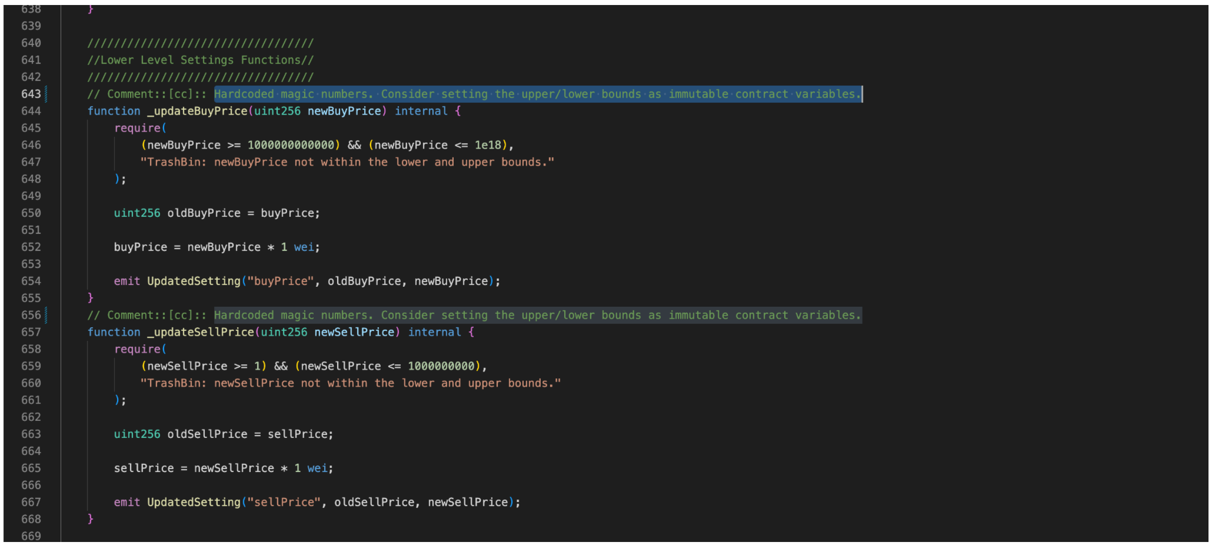
```solidity
    /// @notice The function allows the owner multi-sig to delete an array of indexes from the nftStorage array. Ideally, this
    ///         function will never be needed, but in the event that an NFT is incorrectly withdrawn and a nftStorage
    ///         array entry persists this function can be used to remove the unnecessary index. The indexes array provided
    ///         must be monotonically decreasing.
    /// @param indexes The index array to be deleted. It must be monotonically decreasing.
    // Comment::[cc]:: Consider renaming method to deleteIndexes.
    function deleteIndex(uint256[] memory indexes) external onlyOwner {
        for (uint256 j = 0; j < indexes.length; j++) {
            // Comment::[cc]:: Potential minor annoyance when providing a big list of indexes with one invalid index. Caller would not know which index is wrong.
            require(indexes[j] < nftStorage.length, "TrashBin: index out of bounds.");

            if (j > 0) {
                require(
                    indexes[j - 1] > indexes[j],
                    "Trashbin: indexes array provided is not monotonically decreasing."
                );
            }

            nft memory correspondingData = nftStorage[indexes[j]];

            nftStorage[indexes[j]] = nftStorage[(nftStorage.length - 1)];
            nftStorage.pop();

            emit DeleteIndex(correspondingData.collection, correspondingData.id);
        }
    }
```

7.4 Personal preference is to pass in a paused flag. That way it's less likely to accidentally pause/unpause.



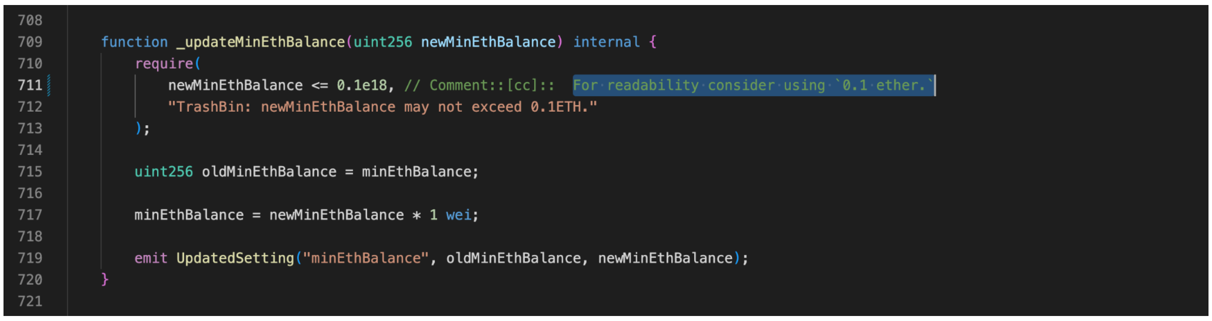
```solidity
    /// @notice This function allows the owner to pause or unpause the core functionality of the contract.
    ///         The functions that will be paused/unpaused are the
    // Comment::[cc]:: Personal preference is to pass in a paused flag. That way it's less likely to accidentally pause/unpause.
    function togglePause() external onlyOwner {
        paused() ? _unpause() : _pause();
    }
```

7.5 Hardcoded magic numbers. Consider setting the upper/lower bounds as immutable contract variables.



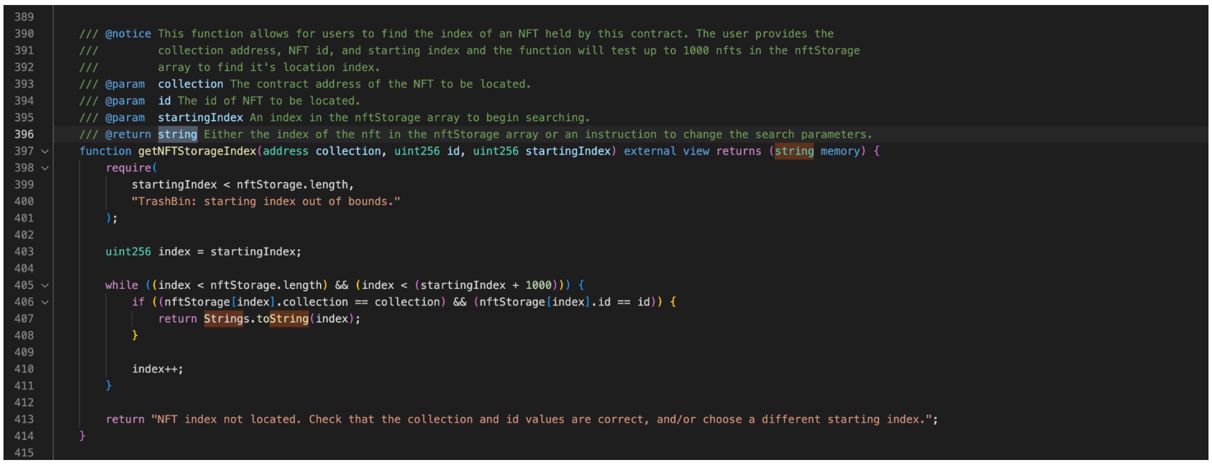
```solidity
    ///////////////////////////////////
    //Lower Level Settings Functions//
    ///////////////////////////////////
    // Comment::[cc]:: Hardcoded magic numbers. Consider setting the upper/lower bounds as immutable contract variables.
    function _updateBuyPrice(uint256 newBuyPrice) internal {
        require(
            (newBuyPrice >= 1000000000000) && (newBuyPrice <= 1e18),
            "TrashBin: newBuyPrice not within the lower and upper bounds."
        );

        uint256 oldBuyPrice = buyPrice;

        buyPrice = newBuyPrice * 1 wei;

        emit UpdatedSetting("buyPrice", oldBuyPrice, newBuyPrice);
    }
    // Comment::[cc]:: Hardcoded magic numbers. Consider setting the upper/lower bounds as immutable contract variables.
    function _updateSellPrice(uint256 newSellPrice) internal {
        require(
            (newSellPrice >= 1) && (newSellPrice <= 1000000000),
            "TrashBin: newSellPrice not within the lower and upper bounds."
        );

        uint256 oldSellPrice = sellPrice;

        sellPrice = newSellPrice * 1 wei;

        emit UpdatedSetting("sellPrice", oldSellPrice, newSellPrice);
    }
```

7.6 For readability consider using `0.1 ether.`



```solidity

    function _updateMinEthBalance(uint256 newMinEthBalance) internal {
        require(
            newMinEthBalance <= 0.1e18, // Comment::[cc]::  For·readability·consider·using·`0.1·ether.`
            "TrashBin: newMinEthBalance may not exceed 0.1ETH."
        );

        uint256 oldMinEthBalance = minEthBalance;

        minEthBalance = newMinEthBalance * 1 wei;

        emit UpdatedSetting("minEthBalance", oldMinEthBalance, newMinEthBalance);
    }

```

7.7 Consider converting the instruction string returned to be a revert reason. That way the DAPP devs would not need to cast indexes to integer as well as not having to write an extra error handler when the contract returns a string that should be interpreted as an error.



```solidity

    /// @notice This function allows for users to find the index of an NFT held by this contract. The user provides the
    ///         collection address, NFT id, and starting index and the function will test up to 1000 nfts in the nftStorage
    ///         array to find it's location index.
    /// @param  collection The contract address of the NFT to be located.
    /// @param  id The id of NFT to be located.
    /// @param  startingIndex An index in the nftStorage array to begin searching.
    /// @return string Either the index of the nft in the nftStorage array or an instruction to change the search parameters.
    function getNFTStorageIndex(address collection, uint256 id, uint256 startingIndex) external view returns (string memory) {
        require(
            startingIndex < nftStorage.length,
            "TrashBin: starting index out of bounds."
        );

        uint256 index = startingIndex;

        while ((index < nftStorage.length) && (index < (startingIndex + 1000))) {
            if ((nftStorage[index].collection == collection) && (nftStorage[index].id == id)) {
                return Strings.toString(index);
            }

            index++;
        }

        return "NFT index not located. Check that the collection and id values are correct, and/or choose a different starting index.";
    }

```