

**San Jose State University**

**Computer Engineering Department**



**CMPE 287 - Software Quality Assurance and Testing**

**Mobile Application Testing with AI Features (Envision AI)**

**Project Team - 9**

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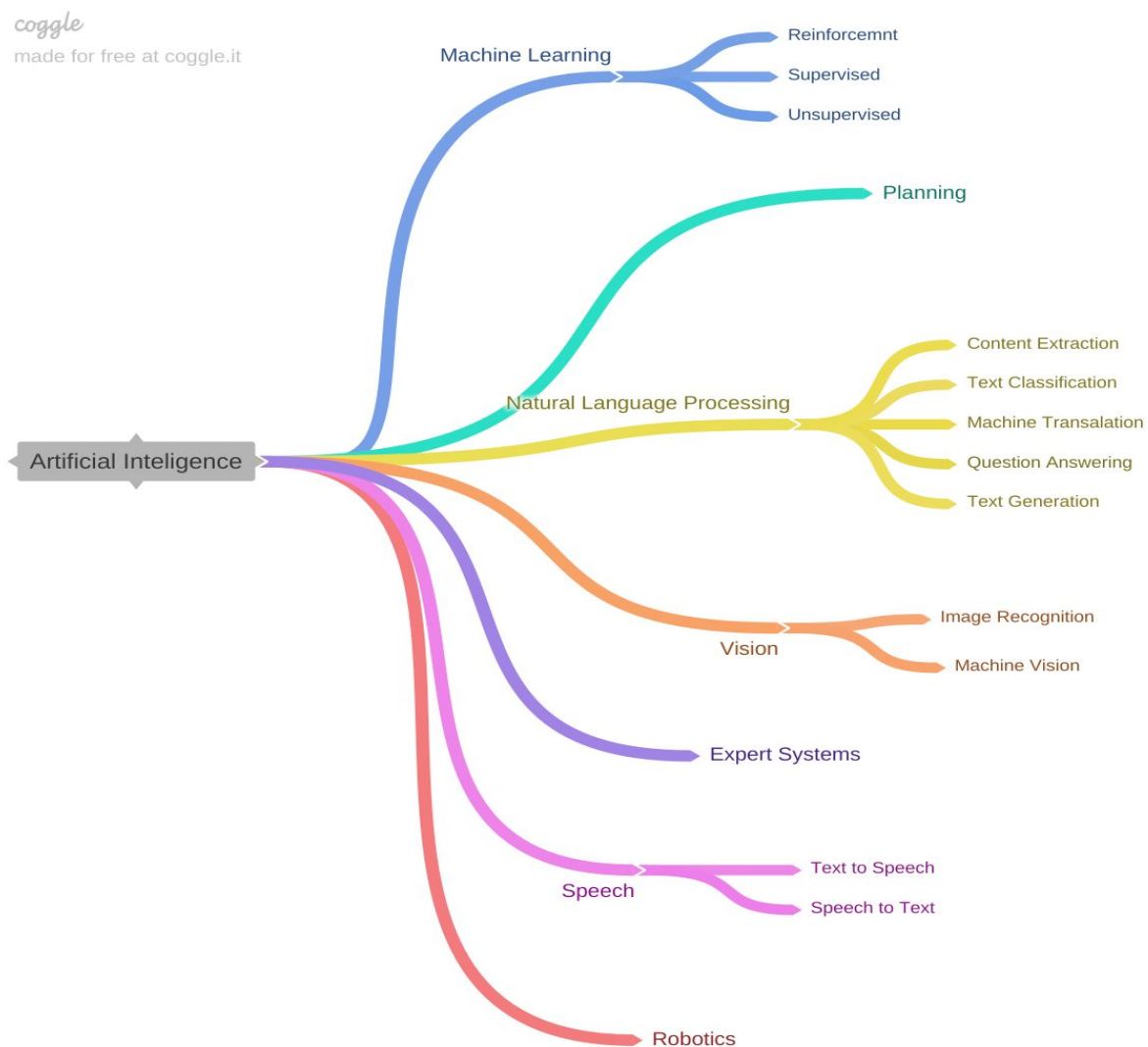
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# **1. AI Function Test Requirement Analysis**

Artificial intelligence is a branch of study of computer science which is targeted to develop smart software solutions which could solve complex problems and perform intelligent tasks. Without the lack of AI systems, these problems can be solved by skilled human experts.

Hence, testing AI applications is an activity of paramount importance. Conventional testing cannot be used to test AI systems efficiently as they will not be able to test all function points of such complex systems. AI testing needs specific techniques to test such functionalities using specialised models and tools.

## 1.1 Artificial Intelligence Classifications - General



AI can be classified into 7 sub branches. They are as follows:

1. **Machine Learning** : Machine Learning is a branch of AI where it enables a system to learn, understand and improve from experience without having to explicitly program the same.  
Types of Machine learning are
  - a. **Reinforcement** : Machine learns from its mistake.
  - b. **Supervised** : Machine is task driven and thereby can predict the next possible value
  - c. **Unsupervised** : Machine is data driven and it can identify clusters.

2. **Planning** : This is a branch of AI which deals with the decision making logic for robots and computers.
3. **Natural Language Processing** : Natural Language Processing is another branch which deals with Human - Computer Interactions and gives the system the ability to understand spoken language.
  - a. **Content Extraction** : By content extraction, human understandable data is extracted from unstructured/semi-structured data
  - b. **Text Classification** : This is a process where the text present in a given document is classified and tagged from pre-existing classification categories.
  - c. **Machine Translation** : This includes conversion of one natural language into another without loss of meaning and content with apt grammar.
  - d. **Question Answering** : This is about the system/machine answering to questions posed by the human operator.
  - e. **Text Generation** : This involves automatic text generation by the system.
4. **Vision**: Machine vision technologies can be used in conjunction with AI software to contribute to image recognition.
  - a. **Image Recognition**: Image recognition is softwares' capability to recognise objects, humans, places and text
  - b. **Machine Vision** : The ability of a machine/system to see and understand.
5. **Expert Systems**: Expert systems are softwares which uses AI methods to address problems centered around a specialised domain. Without the presence of expert systems, these problems would need to be solved by a human expert.
6. **Speech**: AI finds applications in the field of speech recognition and speech synthesis heavily. This enables processing of text to speech or vice versa possible in multiple use cases.
  - a. **Text to speech**: Text to speech technology takes text as input and converts it into voice output. In simple words, it can be understood as a form of speech synthesis.

b. **Speech to text:** Speech to text technology takes audio content as input and transcribes it into text to be viewed on a display device. It is also known as voice recognition technology.

7. **Robotics:** Robotics is a branch of study which spans across multiple disciplines of science and engineering. It is applied to design and develop mechanical robots which can be efficiently used to perform specific tasks.

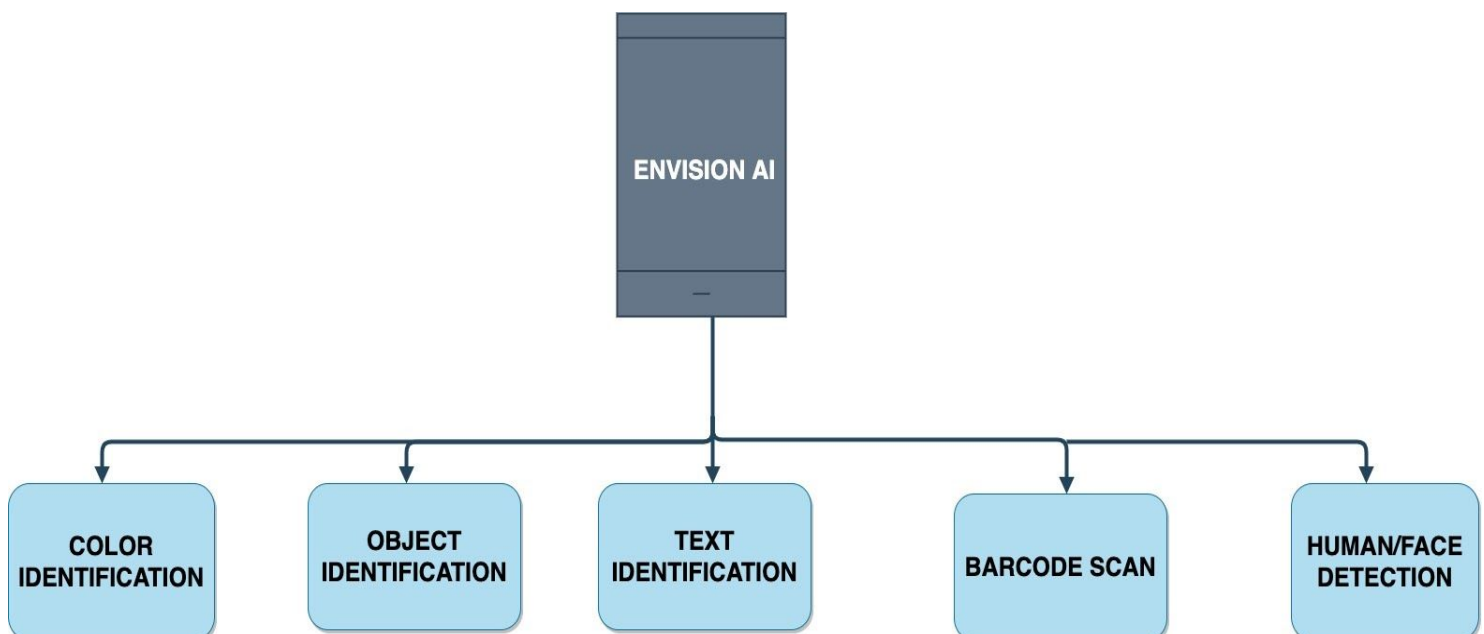
## 1.2 Artificial Intelligence Usage and Test Requirement - Envision AI

The Envision AI is making use of unsupervised Machine learning, image recognition, machine vision, text generation, text to speech AI functionalities.

Our test requirement revolves around testing each of the above features and determining the AI efficiency of the envision AI application. To achieve the same, we would be using different contexts, inputs and considering the possible outputs to arrive at the accuracy and consistency of the application.

Basically our test requirement would be testing each of the function mentioned below

- 1) Color detection
- 2) Object Identification
- 3) Text Identification
- 4) Barcode Scan
- 5) Human/Face Detection



## 2. AI Test Modeling for your selected AI Features

Test Modeling for AI features comprises of several kind of modeling activities which are as follows:

- a) Context Modeling
- b) AI Function Input classification
- c) AI Function Output classification
- d) AI Function Event/Action Classifications

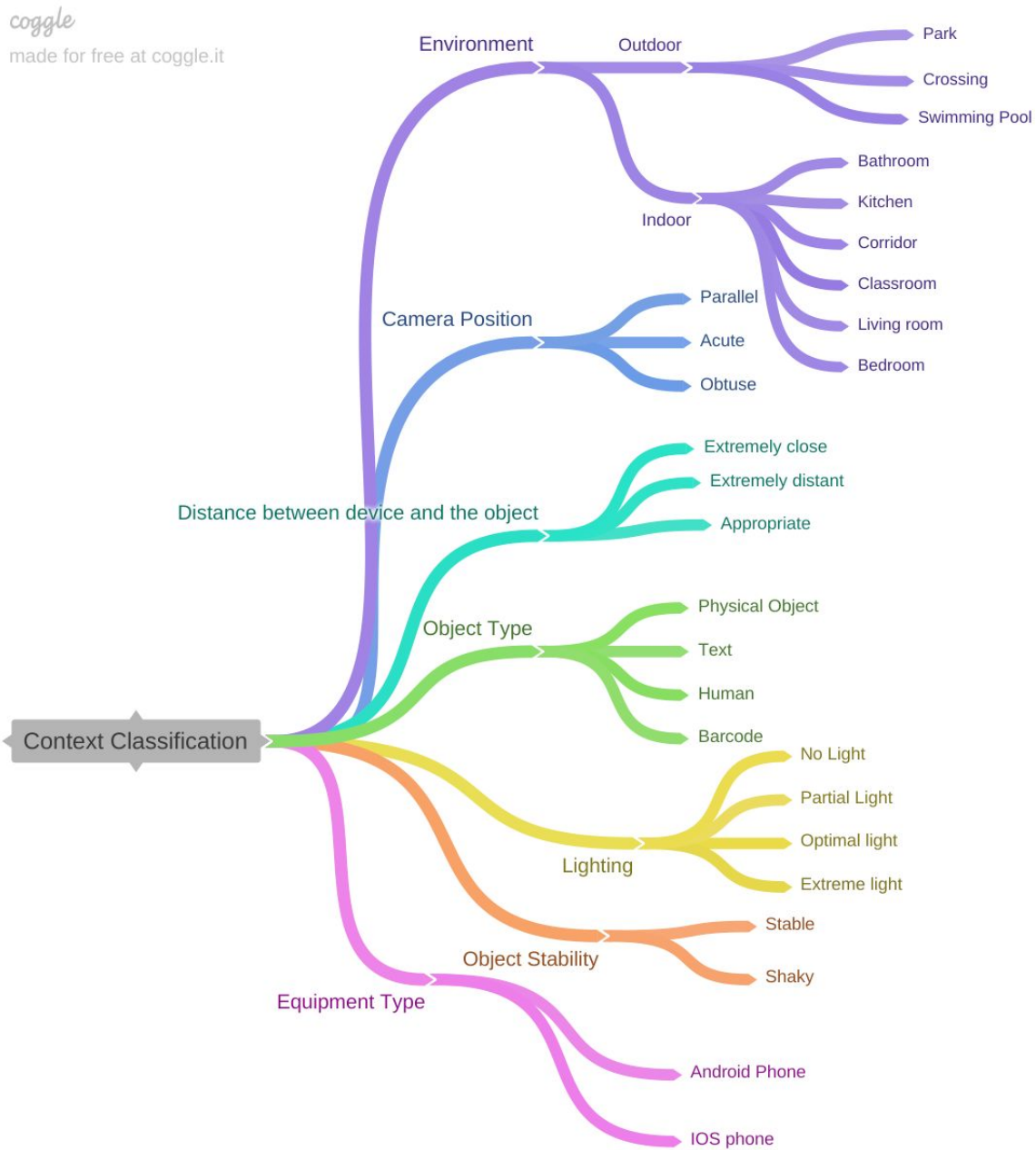
Thus, for testing the AI features, context needs to be identified first. Then, the input data set for the AI needs to be listed. Under the context modeled and AI inputs classified, the list of output generated needs to be identified and classified as output sets. This conversion from input to output would happen as a result of events or actions. These actions can also be classified as action/event sets.

In the subsections below, we have performed test modeling for AI features for Envision application.



## 2.1 Context Modeling for AI Features

For testing of AI features in the Envision app, context modeling has been done to arrive at the spanning tree shown in the figure below.



Context is majorly categorised on the basis of below factors:

- **Environment** in which the Envision app will be tested. Environment can further be classified into indoor and outdoor test conditions.
- **Position of the device** when the camera is pointed on an object in focus. It can be in an acute angle or obtuse angle or in a parallel position with respect to the object.
- **Distance between device and object** when camera is pointed on an object in focus. It can be extremely close or extremely far or at optimal distance from the object.
- **Lighting conditions** in the environment in which the object under focus exists. There can be no light or dim light or optimal light or bright light environment.
- **Stability of the object** in focus. It can be a still object or one in motion.
- **Equipment type** on which Envision app is installed and to be used for testing. Android and iOS variants are the subcategories in this context.

## 2.2 AI Function Input Classifications

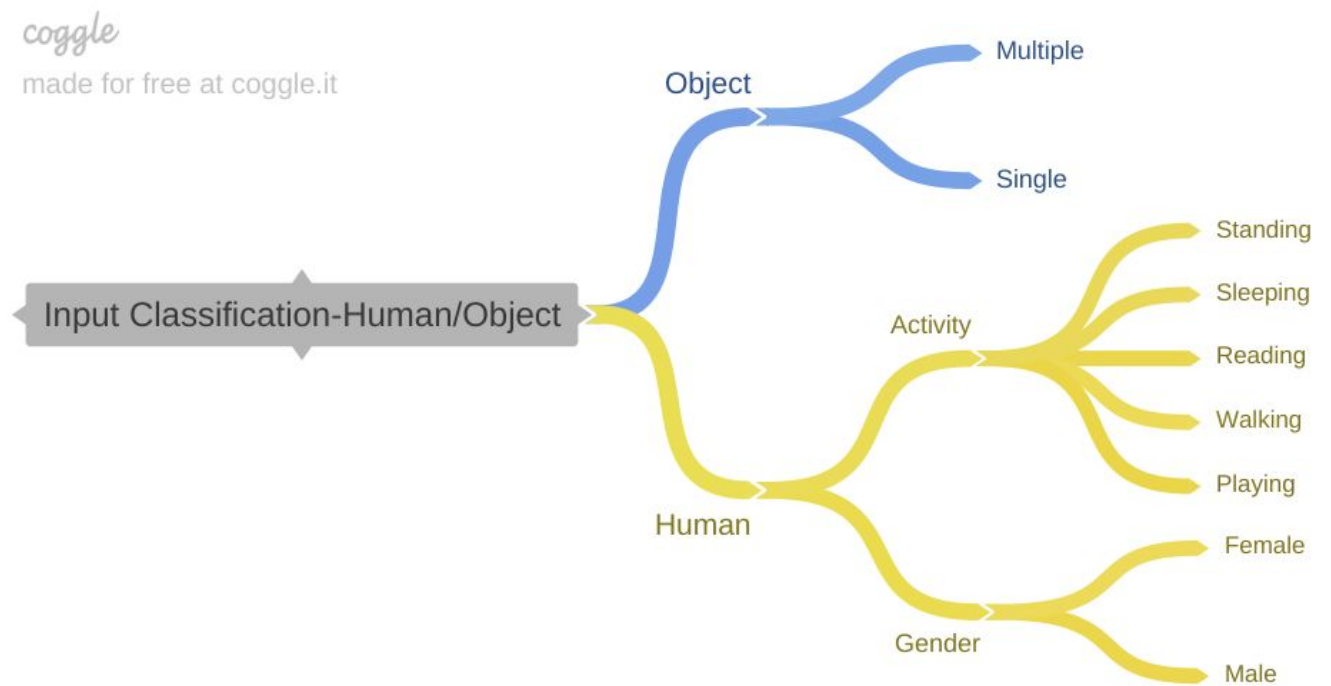
The input dataset to Envision app can be classified into categories as shown in the diagram below. Input to Envision app classification is necessary to identify all possible functional scenarios for testing of AI features:

- **Object:** Envision app camera can be directed at **single** or **multiple** objects when testing for objects in a scene.
- **Human:** Envision app camera can be directed at a human of either male or female **gender** for testing. The person in focus can be involved in any **activity** like reading, playing, walking.
- **Text:** Text in focus of Envision app can be either **handwritten** text or **printed** text. Text **font size** can be too large or too small or optimal. **Text language** under test is Hindi, English and numerical data. **Text content** can be a letter or a word or an entire paragraph.
- **Color:** The object in focus of Envision app can have a primary color or secondary color or tertiary color.
- **Barcode:** The barcode to be scanned by the Envision app can be present on a physical object or display screen of some device like a computer or tablet.

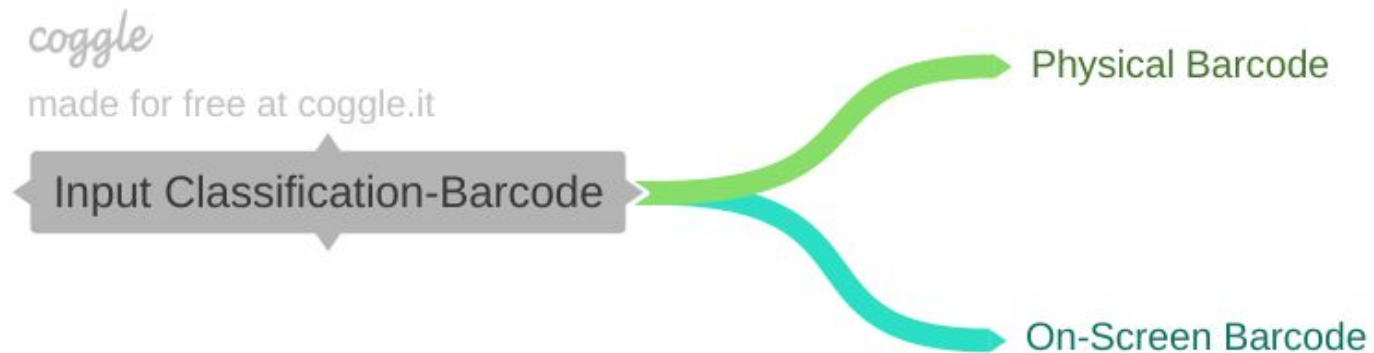
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### 2.2.1 Object/Face Detection AI functionality



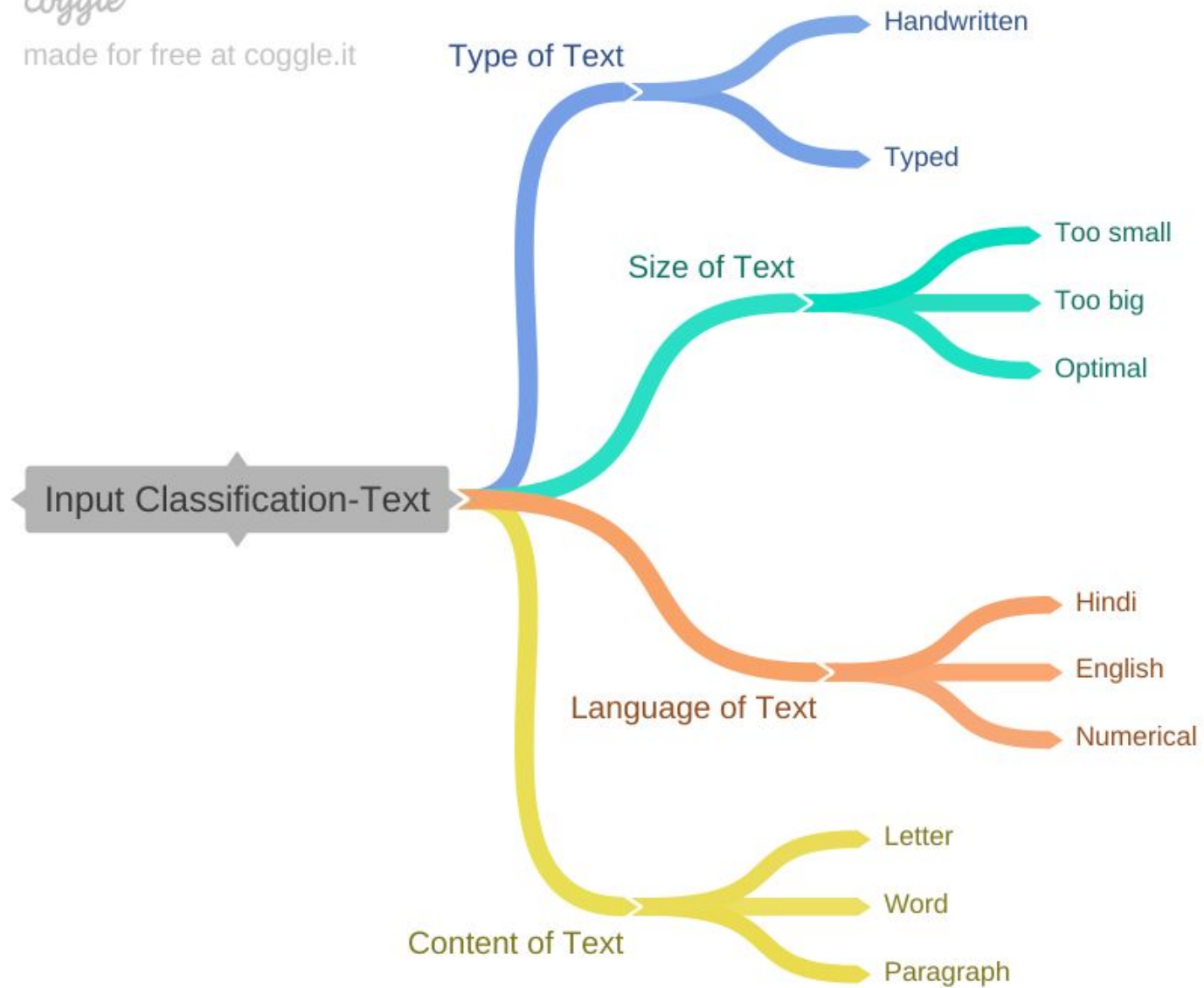
### 2.2.2 Barcode Scanning functionality



### 2.2.3 Text Detection functionality

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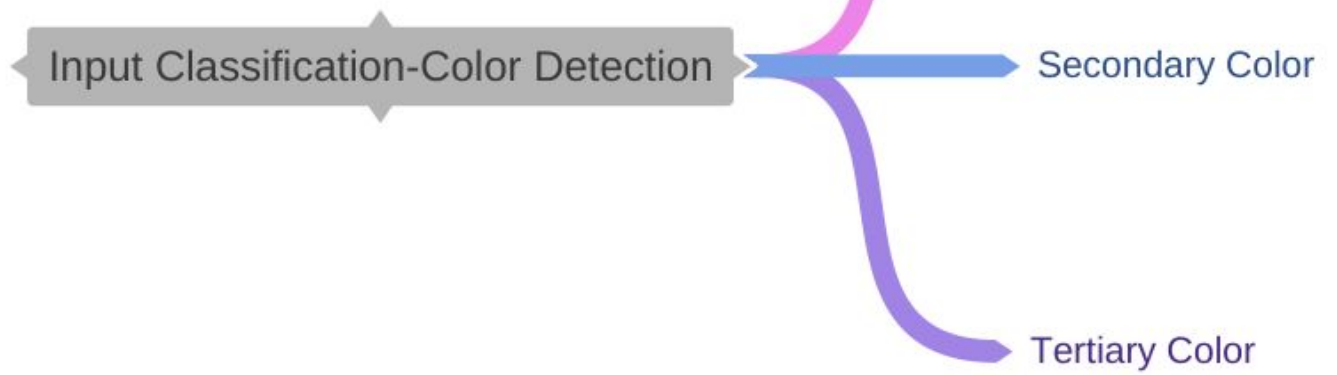
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## 2.2.4 Color Detection functionality

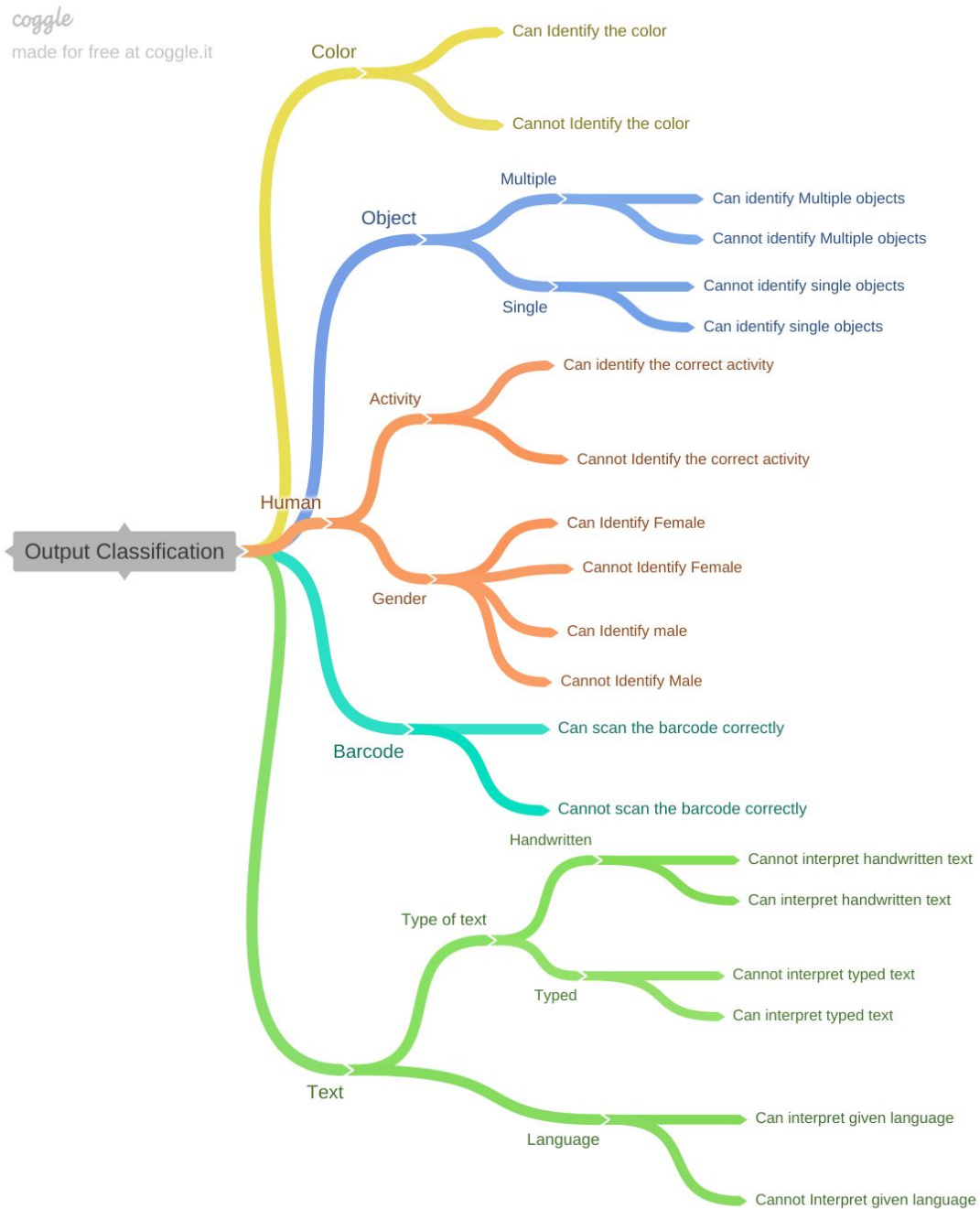
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## 2.3 AI Function Output Classifications

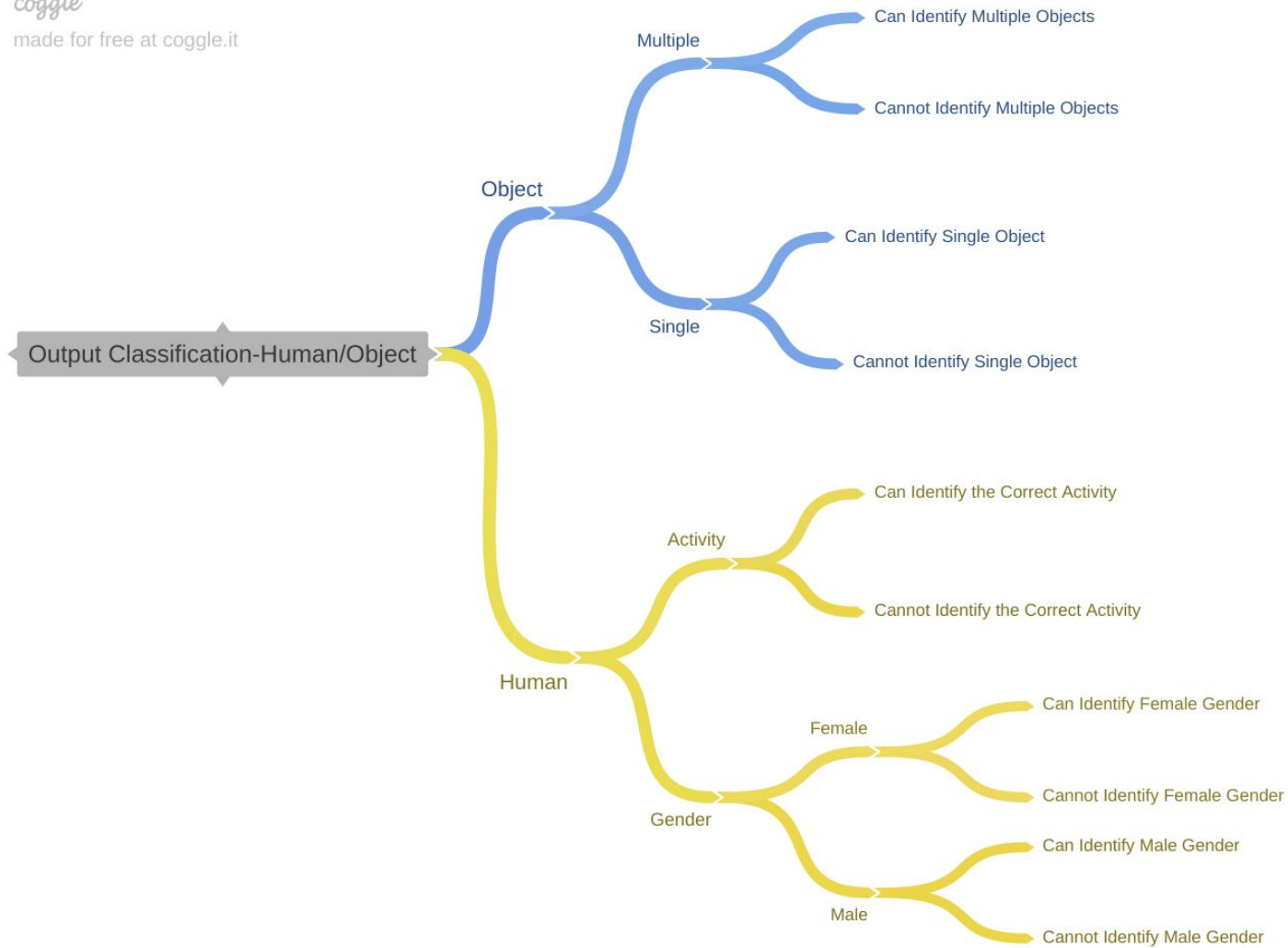
The output from Envision app can be understood as a set which can further be categorised as shown in the figure below.



### 2.3.1 Object/Face Detection AI functionality

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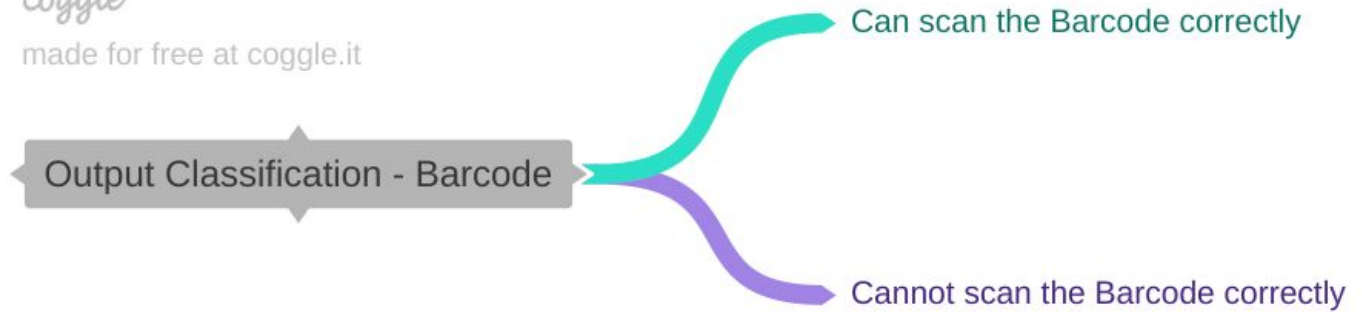




### 2.3.2 Barcode Scanning functionality

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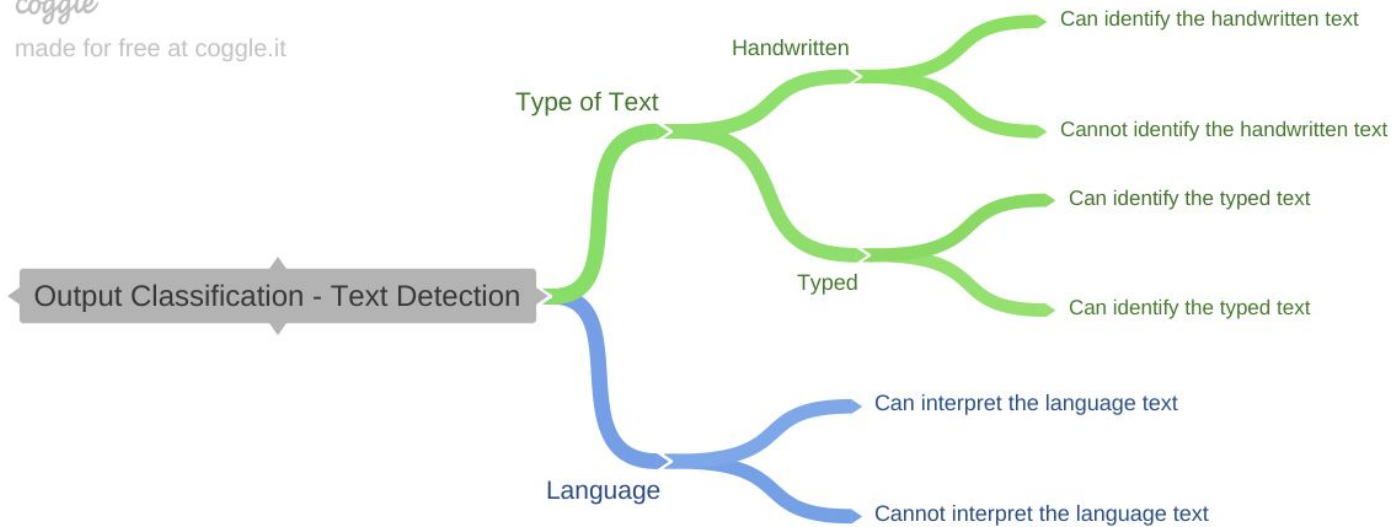
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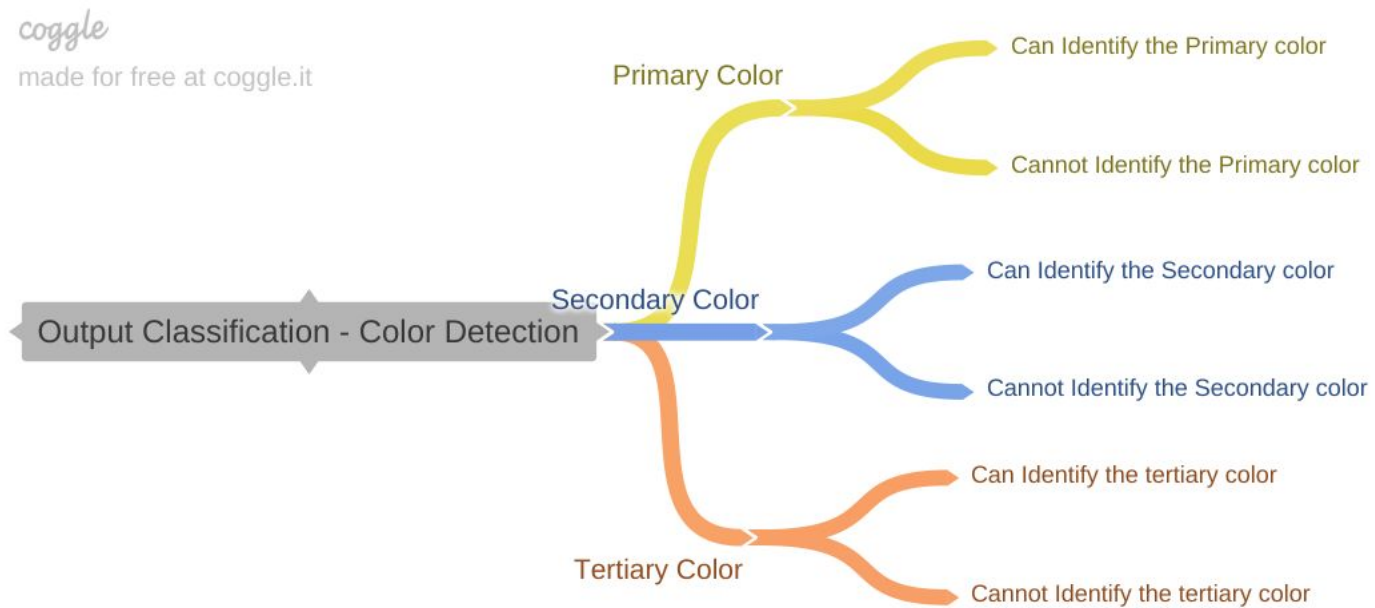
### 2.3.3 Text Detection functionality

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### 2.3.4 Color Detection functionality



The output of Envision app AI features testing can be segregated into below types which can further be divided into different sets of observations:

- Color:
  - ❑ The Envision app can identify the color of an object correctly.
  - ❑ The Envision app cannot identify the color of an object correctly.
- Object:
  - ❑ Multiple objects in focus of Envision app -
    - The Envision app can identify multiple objects in focus correctly.
    - The Envision app cannot identify multiple objects in focus correctly.
  - ❑ Single objects in focus of Envision app -
    - The Envision app can identify single objects in focus correctly.
    - The Envision app cannot identify a single object in focus correctly.
- Human:
  - ❑ Person in focus of Envision app of either gender -
    - The Envision app can identify the correct gender of a person in focus.
    - Envision apps cannot identify the correct gender of a person in focus.
  - ❑ Person in focus of Envision app performing some action -
    - The Envision app can identify the action being performed by a person in focus.
    - Envision app cannot identify the action being performed by a person in focus.

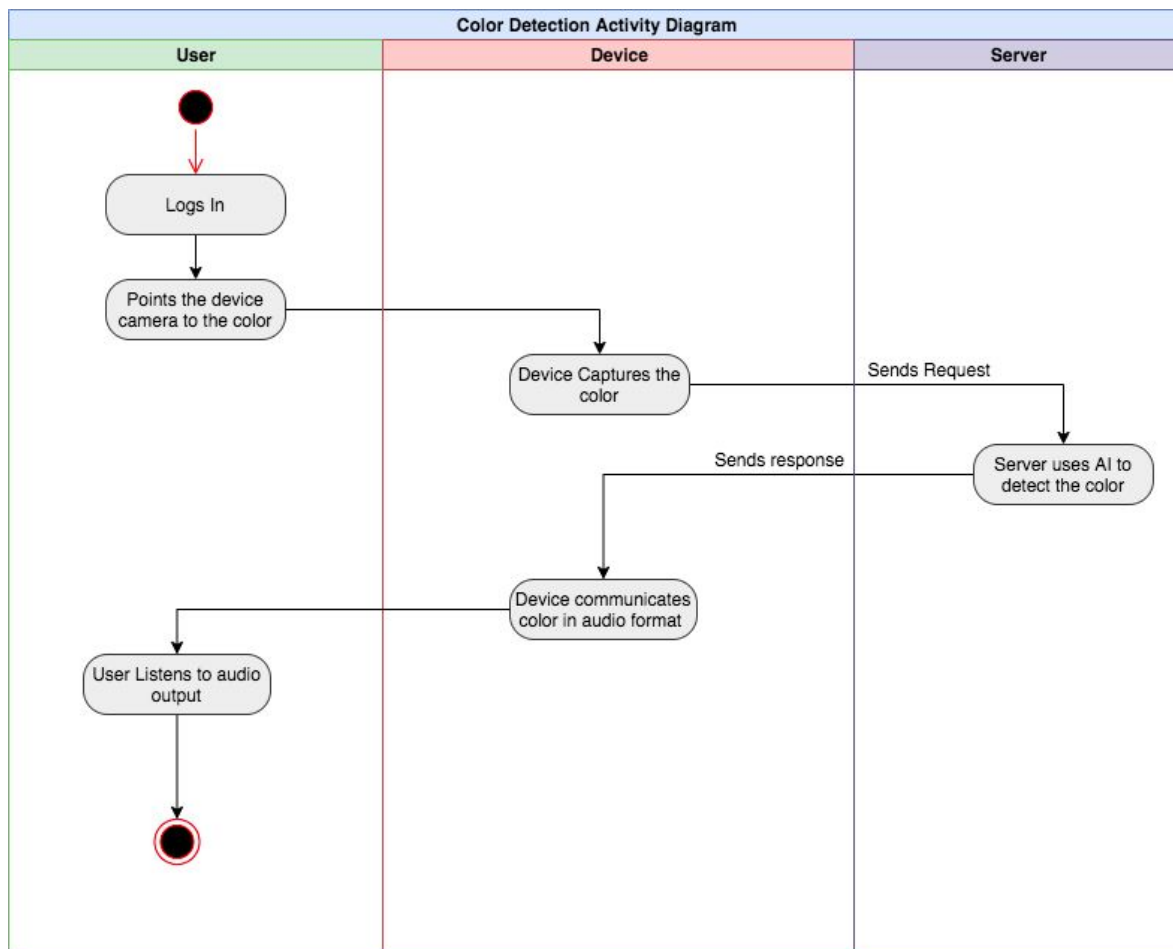
- Barcode:
  - The Envision app can scan the barcode of an object correctly and determine the object to which the barcode actually belongs.
  - The Envision app is unable to scan the barcode of an object correctly.
- Text:
  - ❑ Type of text, i.e. handwritten or typed -
    - The Envision app can read a piece of handwritten text.
    - The Envision app can read a piece of typed text.
    - The Envision app cannot read a piece of handwritten text.
    - The Envision app cannot read a piece of typed text.
  - ❑ Text of different languages, Hindi, English and numeric data tested -
    - The Envision app can interpret language text of different languages correctly.
    - The Envision app cannot interpret language text of different languages correctly.

## 2.4 AI Function Event/Action Classifications

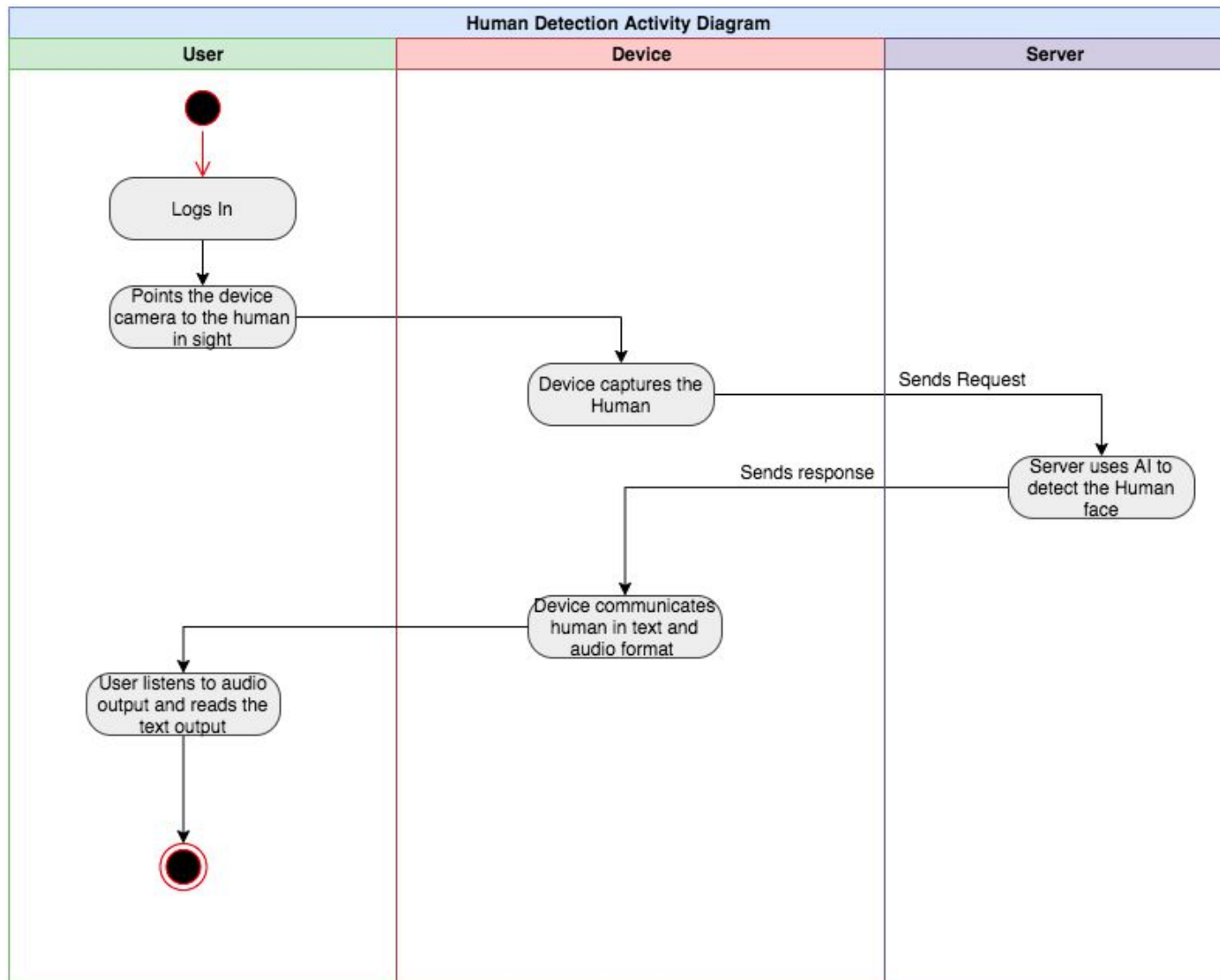
Envision AI application can perform several AI functions each of which is triggered by an event in time. Depending on what functionality is selected by the user, the app takes visual input from the camera and processes it to provide the expected output.

The various events or actions that Envision app can handle are discussed in the subsections below. Each event has been discussed as an activity diagram wherein every entity in scope performs an activity in time. All these activities when seen together as a whole in time sequence end up in completing an AI function of the app.

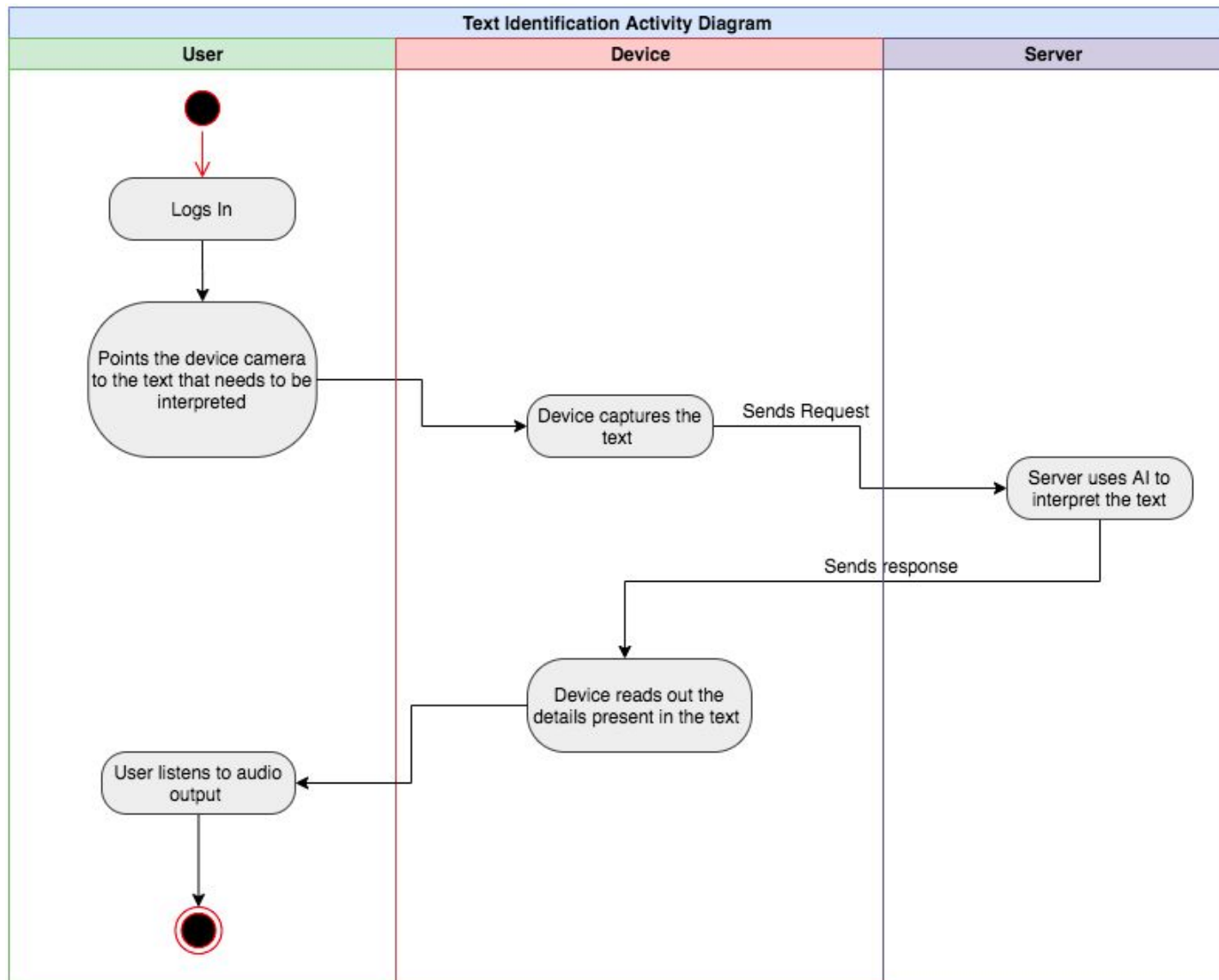
### 2.4.1 Color Detection



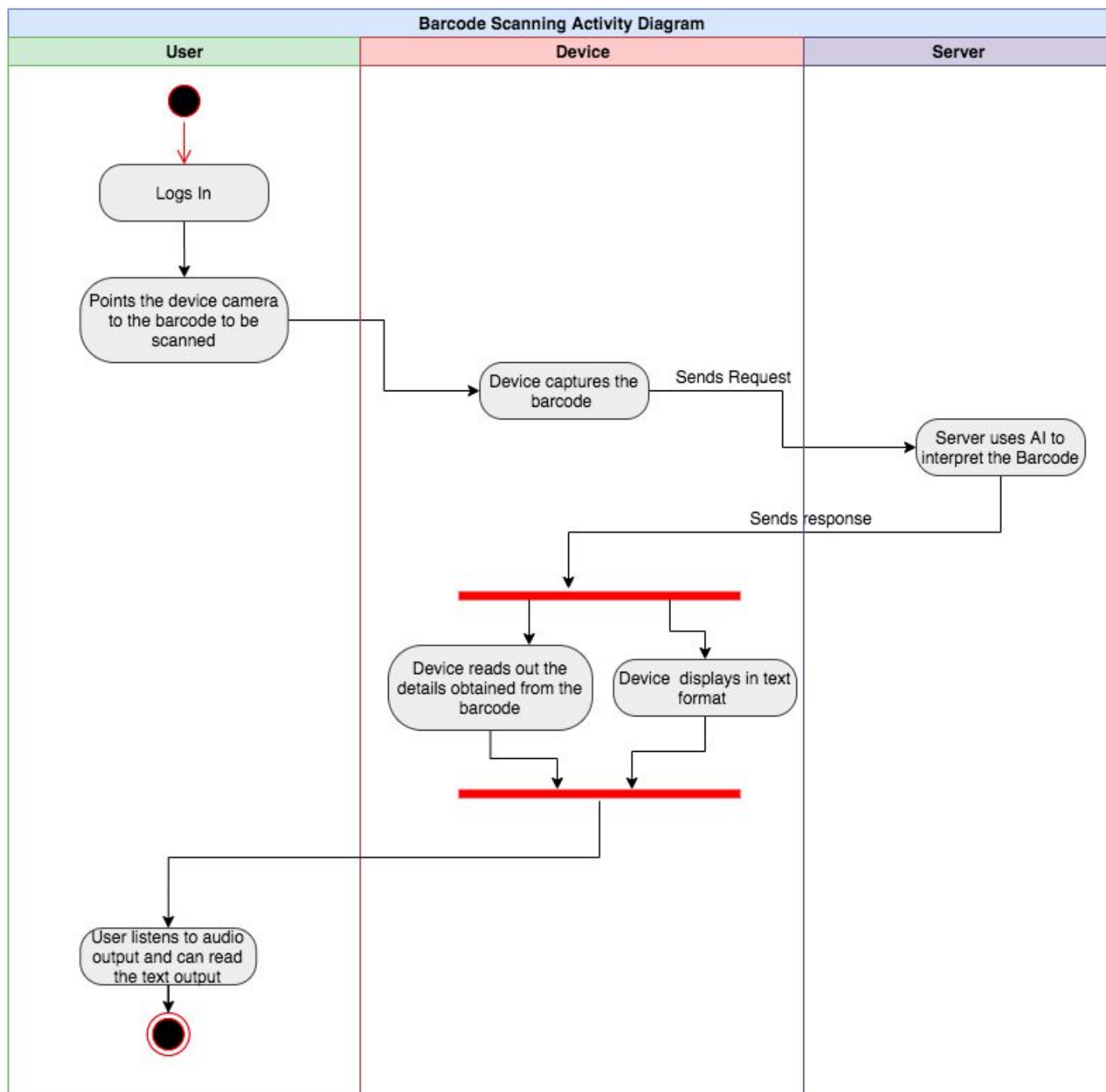
## 2.4.2 Human Identification



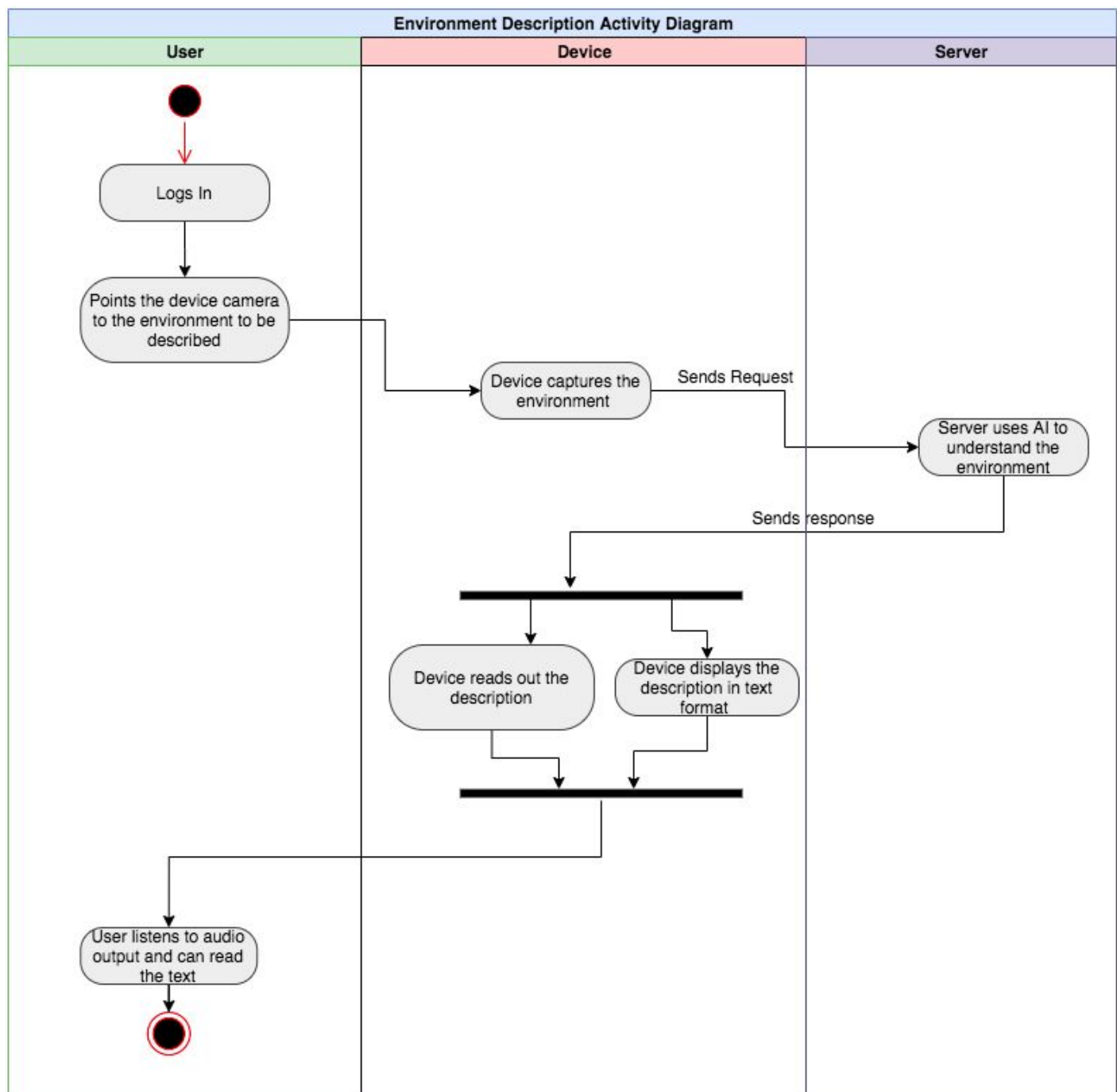
### 2.4.3 Text Interpretation



## 2.4.4 Barcode Scanning



## 2.4.5 Environment Description





2.5 AI Function Classification Decision Table(3D tables)

The below decision tables represent the 3D view of each of the AI functionality. The 3 faces of the 3D model are

- a) AI function context classification view
- b) AI function input classification view
- c) AI function output classification view

2.5.1 Object/Face Detection AI functionality

Rules		R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	R 12	R 13	R 14	R 15	R 16	R 17	R 18	R 19	R 20	R 21	R 22	R 23	R 24	R 25	R 26	R 27	R 28	R 29	R 30	R 31	R 32
CONTEXT CLASSIFICATION VIEW																																	
Environ ment	Outdoor	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Camera Position	Optimal	T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F
Distanc e between the object and the device	Optimal	T	T	T	T	F	F	F	F	T	T	T	T	F	F	F	F	T	T	T	T	F	F	F	F	T	T	T	T	F	F	F	F
Object Stability	Stable	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F
Lighting	Optimal	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F
INPUT CLASSIFICATION VIEW																																	
Object	Single	X	X	X	X	X	X	X	X								X	X	X	X	X	X	X	X									
	Multiple									X	X	X	X	X	X	X	X								X	X	X	X	X	X	X	X	
Human gender	Female	X	X	X	X					X	X	X	X					X	X	X	X				X	X	X	X					





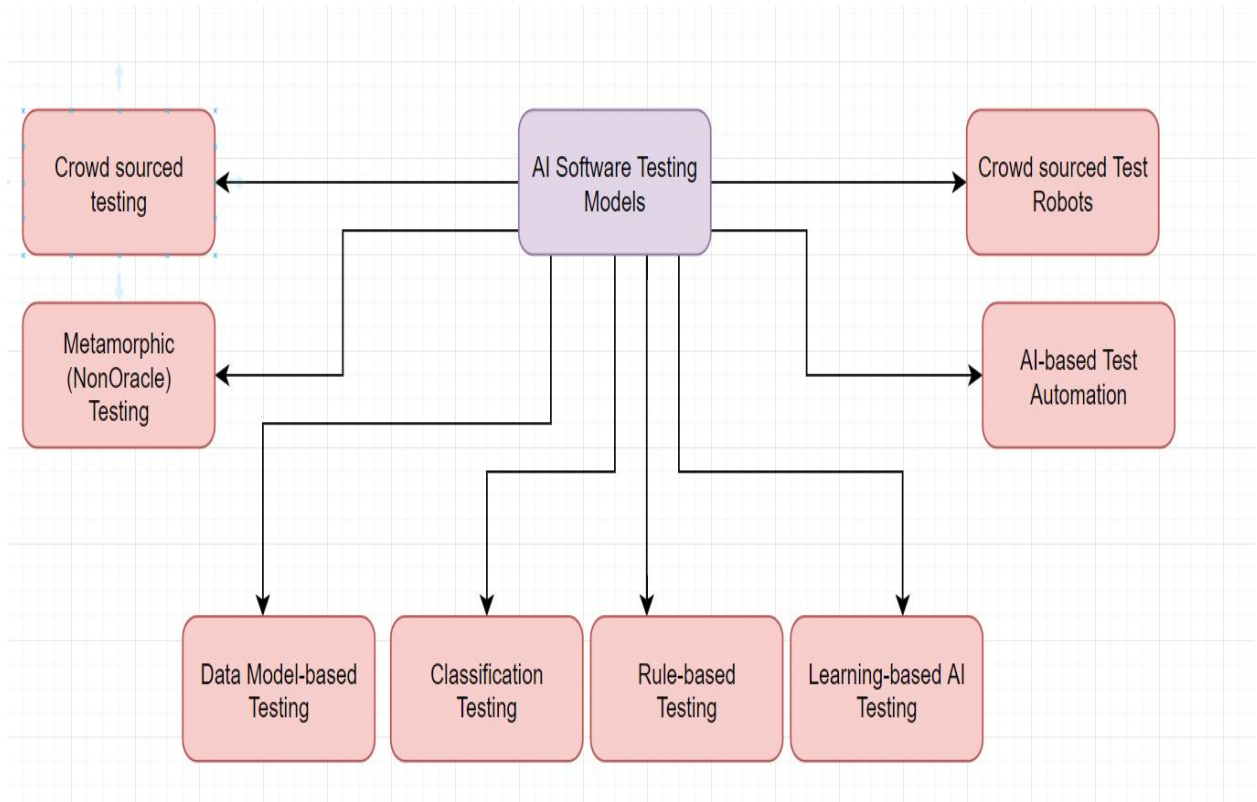


Object Stability	Stable	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T	F	T	F	F		
Lighting	Optimal	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F		
INPUT CLASSIFICATION VIEW																																	
Color	Primary Color	X	X	X	X									X	X	X	X									X	X	X	X				
	Secondary Color					X	X	X	X									X	X	X	X									X	X	X	X
	Tertiary Color									X	X	X	X									X	X	X	X								
OUTPUT CLASSIFICATION VIEW																																	
Correct Detection		O	O	O	O					O	O	O	O					O	O	O	O					O	O	O	O				
Incorrect Detection						O	O	O	O					O	O	O	O					O	O	O	O					O	O	O	O

### 3. AI Function Test Cases with Inputs/Expected Outputs

There are a lot of methods used for testing AI functionalities of Software Applications and/or websites depending on their respective functionalities and Test requirements.

#### 3.1 Test data models



#### 3.1.1 AI Software Testing Models:

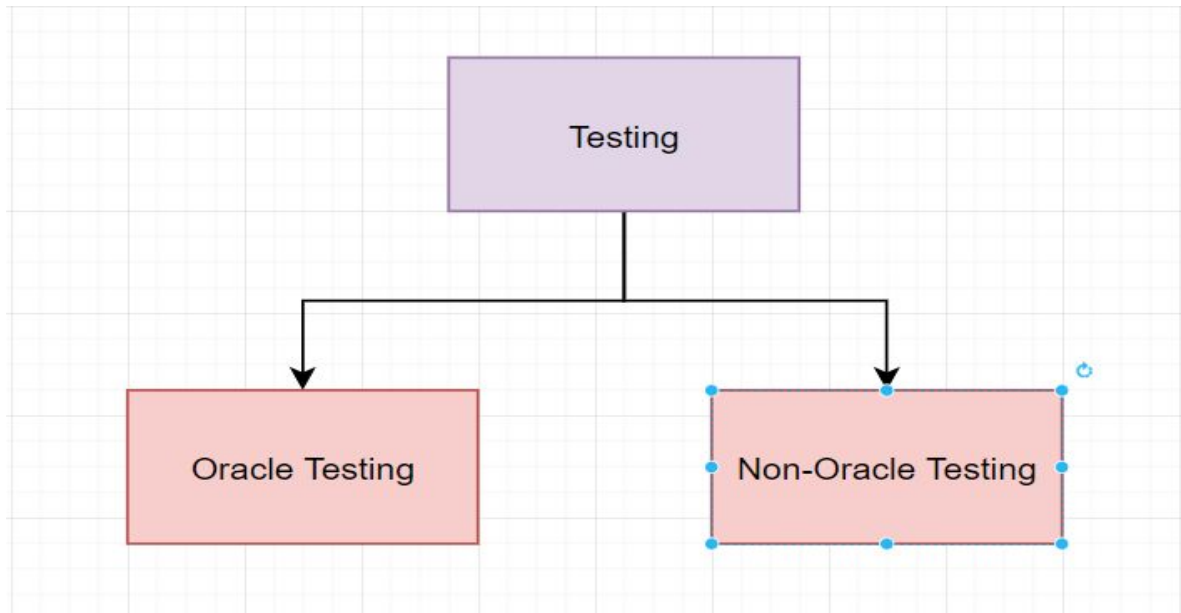
##### Crowdsourced Testing

Crowdsourced Testing refers to usability testing by a bunch of different Testers from different locations. It is a user centric testing method that focuses on Testing from User perspective, emphasises the most on User feedback.

In addition to an inhouse Quality Assurance/ Testing team, the application/ Software is outsourced to be tested by different users to understand the System from their point of view.

Eg. User testing website (<https://www.usertesting.com/>) : A lot of technology giants put their Software Product to be tested on this website and seek user feedback by paying for the video feedback.

### Metamorphic(Non-Oracle) Testing



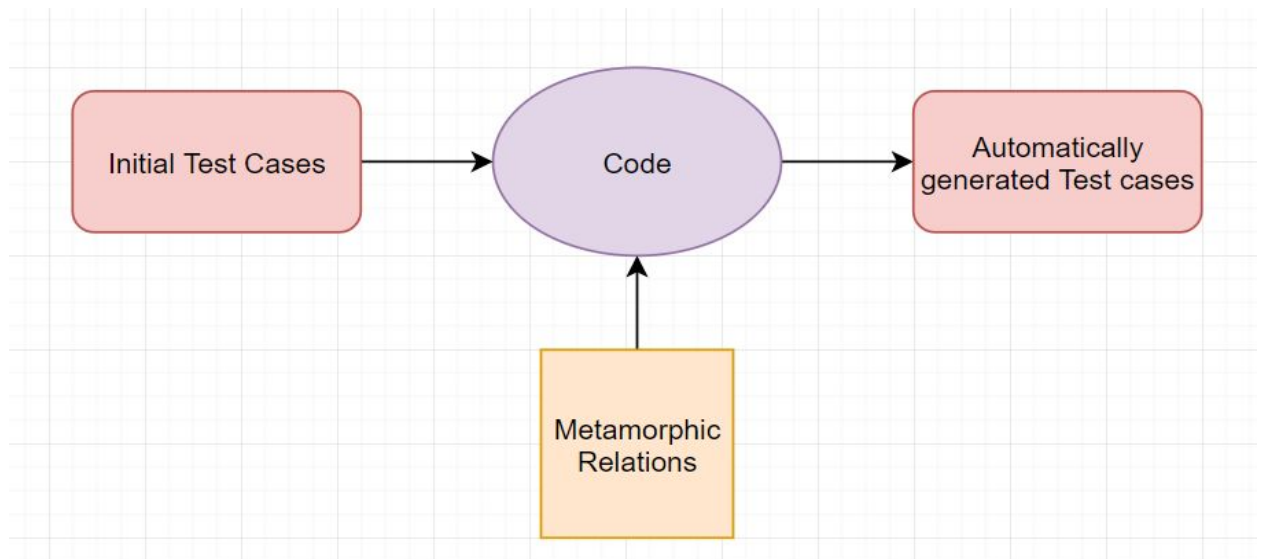
**Oracle Testing:** Oracle Testing is a manual testing method where we have fixed input and fixed expected output.

Disadvantages of Oracle Testing:

- Expensive to design manual test cases
- Cannot guarantee the coverage of all the Test cases.

**Non-Oracle Testing:** Non-oracle testing(Metamorphic Testing) is a Property Based Testing(PBT) where the inputs and expected outputs are not fixed.

This technique is used hugely especially for AI Testing since the requirements and constraints are more likely to change with time in the same.



**Metamorphic Relations:** It is a mathematical property that defines relations between the given input and outputs. So, instead of validating output, validate the relation between input and output.

The main benefit of using this method is that we can expect the output to change in the same way input does. If that doesn't happen, Test case is marked as Fail.

Problem:

- It is complex to generate uniform code.

Solution:

Convert the code into Context Flow Graph(CFG), Train a model and finally determine the metamorphic relation.

## Data Model-based Testing

In Data model- based testing, Runtime behavior of a Software under test is checked against predictions made by any of the below described models.

- Data flow diagram
- Control flow diagram
- Dependency graphs
- Decision tables
- State Transition Machines

## Classification Testing

Classification Testing is a method of AI-Testing that closely resembles one of the Black-box testing methods, Category Partition Testing. We have to create context trees for each AI- Functionality for both inputs and Possible outcomes and design the test Cases keeping in mind all the possible combinations.



## **Rule-based Testing**

As the name suggests, Rule-based technique involves Hard-coded rules, that cannot be changed in the future with the requirements.

AI Implemented through rule-based technique has a Fixed amount of knowledge and limited scope.

Disadvantages:

- Rules cannot be changed. Hence, it is time consuming and expensive.
- In some situations, It is not possible to define rules explicitly.

## **Learning-based AI Testing**

As the name suggests, it is general AI with the Learning Capabilities.

Artificial Intelligence in this method is implemented and tested using Machine Learning Techniques.

No hard rules, you can build rules on the fly.

Ex. Neural Network

## **AI-based Test Automation**

For automatic Test Case generation, especially for Softwares/ Applications having AI features, there are several tools available online.

Following are the AI Test Automation Tools:

- Applitools
- SauceLabs
- Testim
- Sealights
- Test.AI
- Mabl
- ReTest

## **Crowdsourced Test Robots**

Crowdsourced Test Robots are the third party service providers that facilitates AI Automation Testing with a few simple modifications and automatically generates Test reports as well as bug reports.

Disadvantages:

- Can be ambiguous if the algorithm is not trained properly
- Expensive

## 3.2 Test case reports

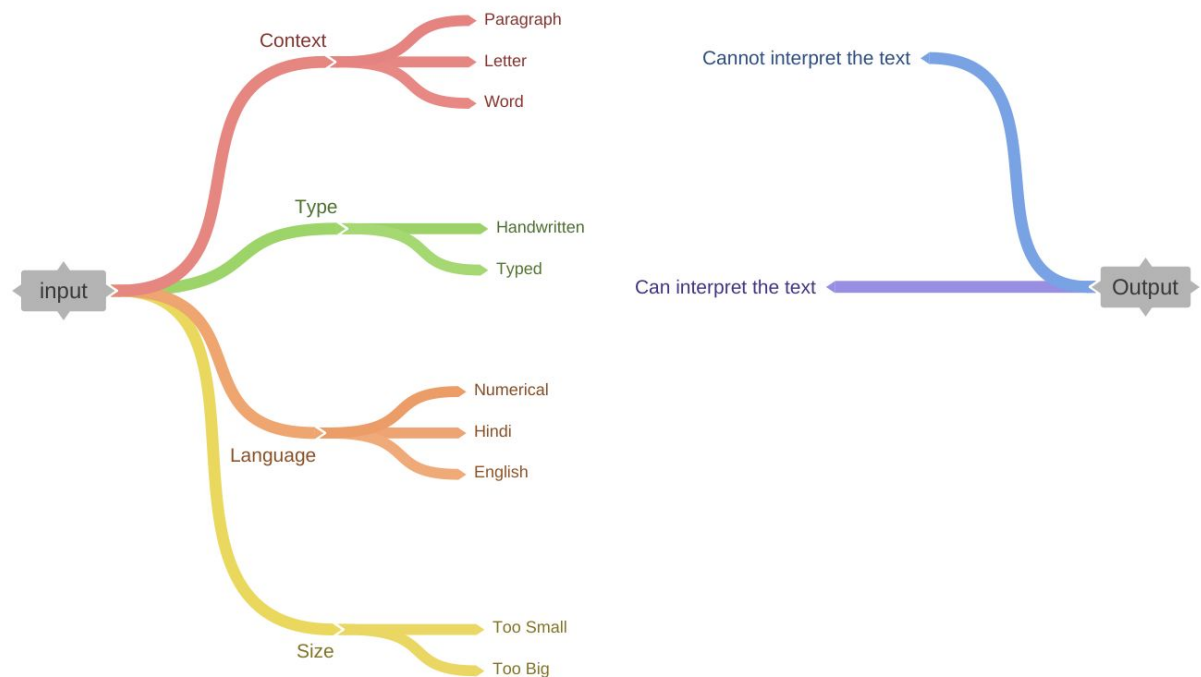
Our team has used three models in total for AI Functionality Testing.

1. **Crowdsourced Testing:** Each team member has tested all the functionalities present in the application, Screenshots attached in the Deliverable 1.
2. **Data model-based Testing:** For Data Model based testing, We have used Decision Tables as a Data model and designed test cases for the same(Deliverable 1).
3. **Classification Testing:** In this method, we have designed test cases by permutation and combination of all possible inputs and outputs from the designed Classification context diagram.

### 3.2.1 Text Detection Functionality

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#### Text Detection Functionality



Test Case#	Test Steps	Expected Results	Test Case Status	Actual Results
E_01	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on a handwritten word in English where text size is too small.	The Envision AI app should detect the text.	Pass	The Envision AI App detects the text successfully.
E_02	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on a handwritten word in English where text size is too large.	The Envision AI app should detect the text.	Fail	The Envision AI App does not detect the text successfully.
E_03	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on a handwritten word in English where text size is optimal.	The Envision AI app should detect the text.	Pass	The Envision AI App detects the text successfully.
E_04	Step1:Connecttest mobile device to working Wifi	The Envision AI app should detect the text.	Pass	The Envision AI App detects the text

	<p>network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on a Typed word in English where text size is too large.</p>			successfully.
E_05	<p>Step1:Connecttest mobile device to working Wifi network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on a Typed word in English where text size is too Small.</p>	The Envision AI app should detect the text.	Pass	The Envision AI App detects the text successfully.
E_06	<p>Step1:Connecttest mobile device to working Wifi network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on a Typed word in English where text size is optimal.</p>	The Envision AI app should detect the text.	Pass	The Envision AI App detects the text successfully.
E_07	<p>Step1:Connecttest mobile device to working Wifi network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on a Handwritten word in Hindi where text</p>	The Envision AI app should detect the text.	Fail	The Envision AI App does not detect the text successfully.

	size is too large.			
E_08	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on a handwritten word in Hindi where text size is too Small.	The Envision AI app should detect the text.	Fail	The Envision AI App does not detect the text successfully.
E_09	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on a handwritten word in Hindi where text size is optimal.	The Envision AI app should detect the text.	Fail	The Envision AI App does not detect the text successfully.
E_10	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on a Typed word in Hindi where text size is too large.	The Envision AI app should detect the text.	Pass	The Envision AI App detects the text successfully.

<b>Context Format</b>	
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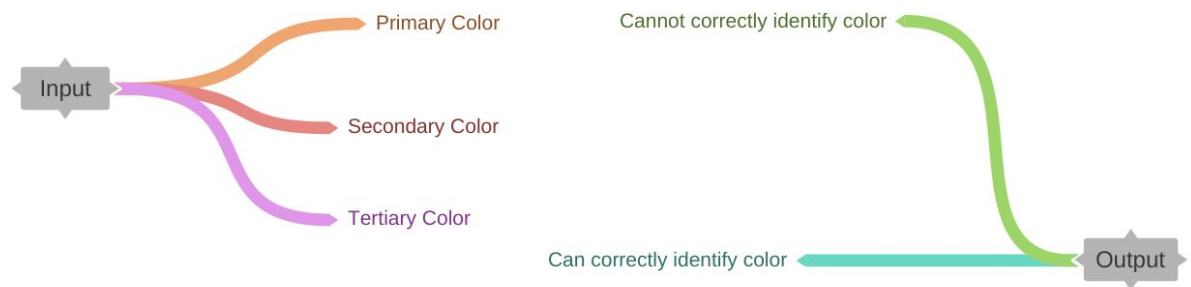
Parameters	Type, Size, Language, Context
Description	10!/2! = 99 Test cases 68 Pass
Test Performed By	Noopur Mehta
Test Type	Classification (Context-based) Testing

### 3.2.2 Color Detection Functionality

*coggle*

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#### Color Detection Functionality



Test Case#	Test Steps	Expected Results	Test Case Status	Actual Results
E_01	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on primary color(Red).	Envision AI should detect the color successfully.	Pass	Envision AI App detects the color successfully.
E_02	Step1:Connecttest mobile device to	Envision AI should detect	Pass	Envision AI App detects

	<p>working Wifi network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on primary color(Yellow).</p>	the color successfully.		the color successfully.
E_03	<p>Step1:Connect test mobile device to working Wifi network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on primary color(Blue).</p>	Envision AI should detect the color successfully.	Pass	Envision AI App detects the color successfully.
E_04	<p>Step1:Connecttest mobile device to working Wifi network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on secondary color(Green).</p>	Envision AI should detect the color successfully.	Fail	Envision AI App doesn't detect the color successfully.
E_05	<p>Step1:Connecttest mobile device to working Wifi network.</p> <p>Step 2: Enter valid credentials for Envision app</p> <p>Step 3: Focus the camera on secondary color(Orange).</p>	Envision AI should detect the color successfully.	Pass	Envision AI App detects the color successfully.

E_06	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on secondary color(Purple).	Envision AI should detect the color successfully.	Fail	Envision AI App doesn't detect the color successfully.
E_07	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on Tertiary color(yellow-orange).	Envision AI should detect the color successfully.	Pass	Envision AI App detects the color successfully.
E_08	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on Tertiary color(red-orange)	Envision AI should detect the color successfully.	Fail	Envision AI App doesn't detect the color successfully.
E_09	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on	Envision AI should detect the color successfully.	Fail	Envision AI App doesn't detect the color successfully.



	Tertiary color( red-purple).			
E_10	Step1:Connecttest mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus the camera on Tertiary color( yellow-green).	Envision AI should detect the color successfully.	Fail	Envision AI App doesn't detect the color successfully.

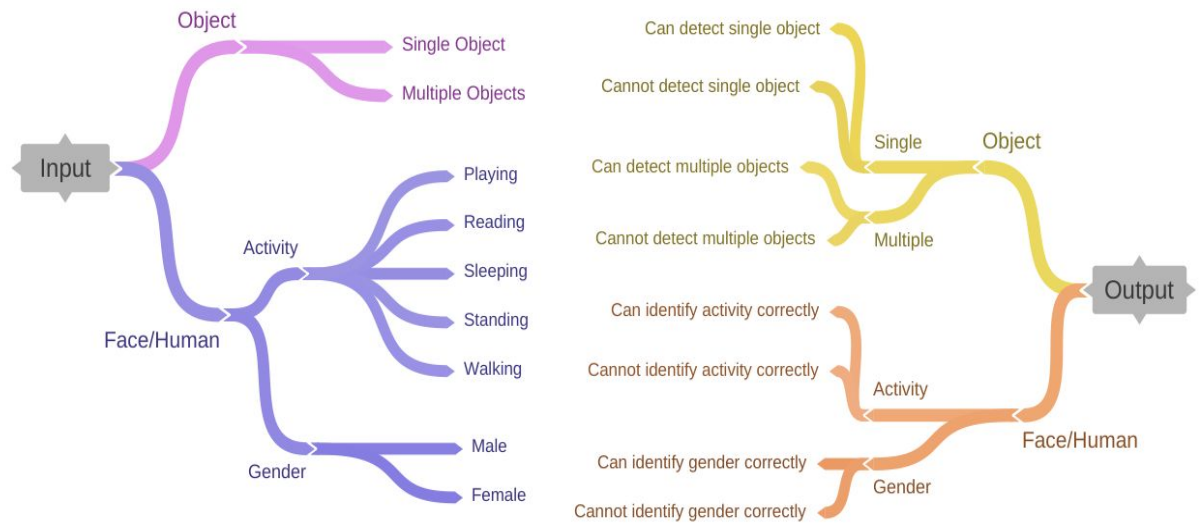
<b>Context Format</b>	
Parameters	Type, Size, Language, Context
Description	3*3*4 = 35 Test cases 24 Pass
Test Performed By	Noopur Mehta
Test Type	Classification (Context-based) Testing

### 3.2.3 Object/ Face Detection Functionality

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#### Object/ Face Detection



Test Case#	Test Steps	Expected Results	Test Case Status	Actual Results
E_01	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on single object.	Envision AI App should be able to identify an Object.	Pass	Envision AI App identifies object successfully.
E_02	Step1:Connect test mobile device to working Wifi	Envision AI App should be able to identify an Object.	Fail	Envision AI App doesn't identify objects successfully.

	network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on Multiple objects.			
E_03	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on a Male who's Standing.	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Fail	Envision AI App doesn't identify Gender correctly..
E_04	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on a Male who's Sleeping.	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Pass	Envision AI App identifies Gender & Activitycorrectly .
E_05	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Fail	Envision AI App doesn't identify Activity/Gender correctly..

	Step 3: Focus camera on a Male who's Walking.			
E_06	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on a Male who's Playing.	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Fail	Envision AI App doesn't identify Gender/Activity correctly.
E_07	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on a Male who's Reading.	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Pass	Envision AI App identifies Gender & Activity correctly.
E_08	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on a Female who's Standing.	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Pass	Envision AI App identifies Gender & Activity correctly.

E_09	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on a Female who's Walking.	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Pass	Envision AI App identifies Gender & Activity correctly.
E_10	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus camera on a Male who's Sleeping.	Envision AI App should be able to identify an Gender and Activity of a person correctly.	Pass	Envision AI App identifies Gender & Activity correctly.

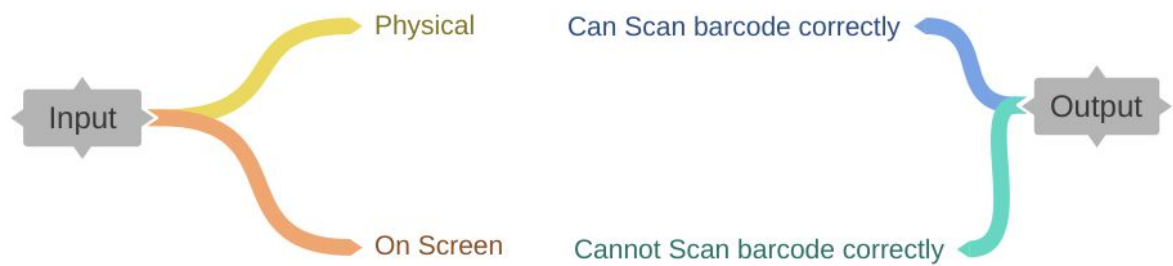
<b>Context Format</b>	
Parameters	Number of objects, Activity, Gender
Description	8!/2! = 86 Test Cases 74 Passed
Test Performed By	Noopur Mehta
Test Type	Classification (Context-based) Testing

### 3.2.4 Barcode Detection Functionality

coggle

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#### Barcode Scanning Functionality



Test Case#	Test Steps	Expected Results	Test Case Status	Actual Results
E_01	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus and try to scan the clear barcode on a physical object.	Envision AI app should scan the barcode successfully.	Pass	Envision AI App scans the barcode successfully.
E_02	Step1:Connect test mobile device to working Wifi network. Step 2: Enter	Envision AI app should scan the barcode successfully.	Failed	Envision AI App doesn't scan the barcode successfully.

	valid credentials for Envision app Step 3: Focus and try to scan the blurred barcode on a physical object.			
E_03	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus and try to scan the clear barcode on a Screen.	Envision AI app should scan the barcode successfully.	Pass	Envision AI App scans the barcode successfully.
E_04	Step1:Connect test mobile device to working Wifi network. Step 2: Enter valid credentials for Envision app Step 3: Focus and try to scan the blurred barcode on Screen.	Envision AI app should scan the barcode successfully.	Fail	Envision AI App doesn't scan the barcode successfully.

Context Format	
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Parameters	Number of objects, Activity, Gender
Description	2*2 = 4 Test Cases 2 Passed
Test Performed By	Noopur Mehta
Test Type	Classification (Context-based) Testing

### 3.3 Test case analysis (statistics)

#### 3.3.1 Test Result for Text Detection functionality

Text Detection	Accuracy	Specificity	Consistency
On Screen text - English	100%	100%	100%
On Screen text - Hindi	100%	100%	100%
Handwritten text - English	100%	100%	100%
Handwritten text - Hindi	70%	50%	80%

#### 3.3.2 Test Result for Color Detection functionality

Color Detection	Accuracy	Specificity	Consistency
Primary Color	80%	75%	60%



<b>Secondary Color</b>	40%	30%	50%
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### 3.3.3 Test Result for Object/FaceDetection functionality

<b>Color Detection</b>	<b>Accuracy</b>	<b>Specificity</b>	<b>Consistency</b>
<b>Object</b>	90%	85%	90%
<b>Face</b>	100%	95%	90%

### 3.3.4 Test Result for Barcode Scanning functionality

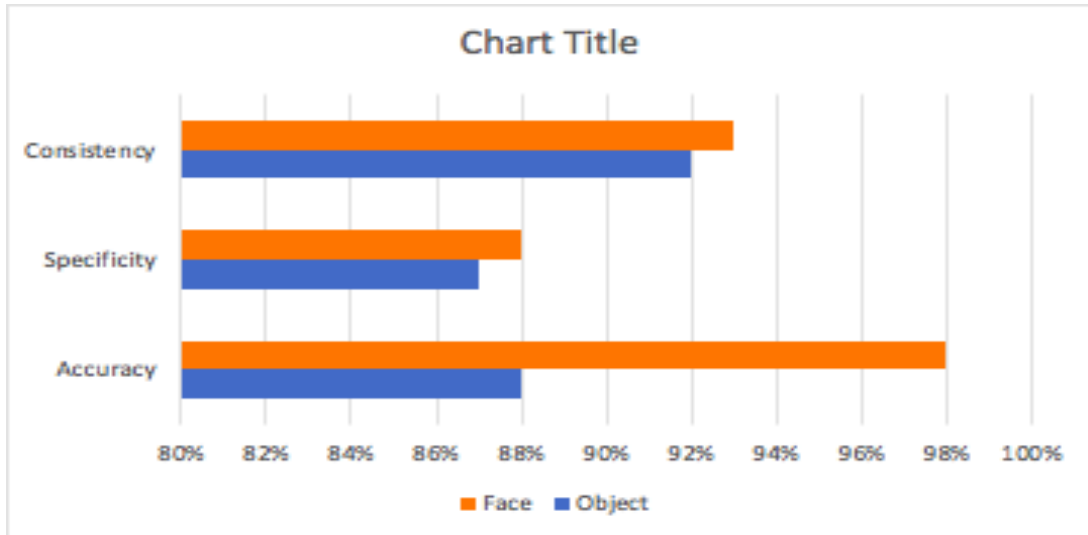
<b>Color Detection</b>	<b>Accuracy</b>	<b>Specificity</b>	<b>Consistency</b>
<b>Physical Barcode</b>	80%	70%	80%
<b>On Screen Barcode</b>	80%	70%	80%

## 4. AI Function Test Results and Test Criteria

### 4.1 AI test model-based test results analysis, test complexity, and test result statistics

#### 4.1.1 Test result for object/face detection AI functionality

	Accuracy	Specificity	Consistency
Object	88%	87%	92%
Face	98%	88%	93%

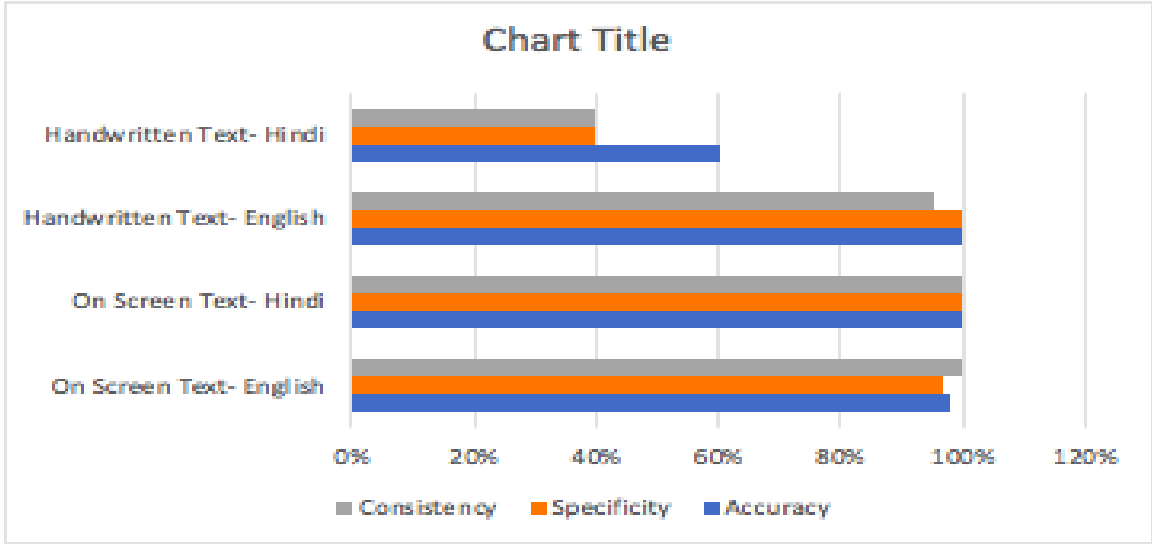


**Complexity:** The test case complexity for the object/face detection functionality is moderate. Average test case complexity will be  $O(n)$ .

#### 4.1.2 Test result for text detection functionality

	Accuracy	Specificity	Consistency
On Screen Text-English	98%	97%	100%
On Screen Text- Hindi	100%	100%	100%
Handwritten Text-English	100%	100%	95%
Handwritten Text-	60%	40%	40%

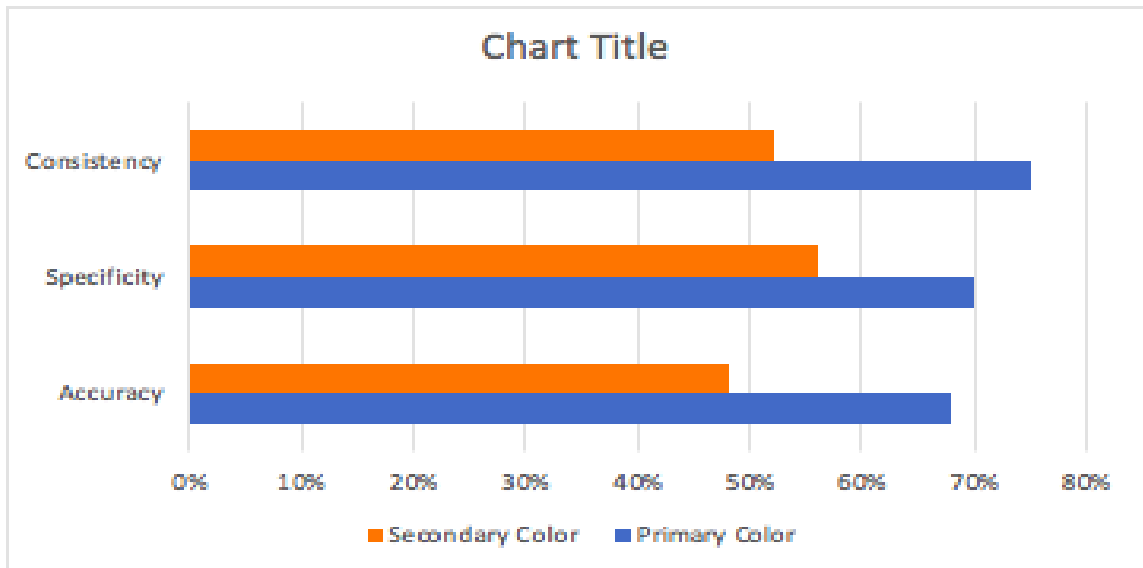
Hindi			
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**Complexity:** The test case complexity for the text detection functionality is moderate. Average test case complexity will be  $O(n \log n)$ .

#### 4.1.3 Test result for color detection functionality

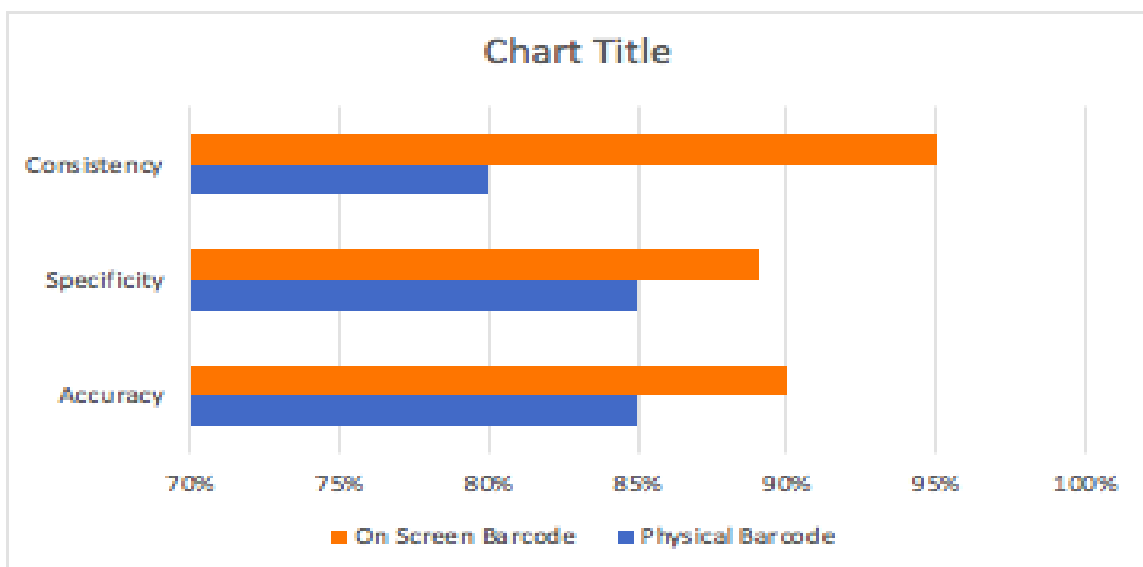
	Accuracy	Specificity	Consistency
Primary Color	68%	70%	75%
Secondary Color	48%	56%	52%



**Complexity:** The test case complexity for the color detection functionality is moderate. Average test case complexity will be  $O(n)$ .

#### 4.1.4 Test result for barcode scanning functionality

	Accuracy	Specificity	Consistency
Physical Barcode	85%	85%	80%
On Screen Barcode	90%	89%	95%



**Complexity:** The test case complexity for the barcode detection functionality is moderate. Average test case complexity will be  $O(n)$ .

## 4.2 AI Function bug analysis

### 4.2.1 Large size Text (English) Detection

**Problem ID:** ENV\_BUG\_01  
**Current software name:** Envision AI  
**Release number and version number:** 1  
**Test Type:** Conventional Testing  
**Reported By:** Atharva Munshi  
**Reported Date:** 11 April 2020  
**Test\_case\_ID:** E\_02  
**Feature Name:** Text detection  
**Problem severity:** Major

#### **Problem summary:**

The application is not able to detect large size text written in English properly.

#### **How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the document which has the handwritten text. The text size should be too large.

Step 5: The envision app doesn't detect the English text successfully and thus the issue is replicated.

### 4.2.2 Large size Text (Hindi) Detection

**Problem ID:** ENV\_BUG\_02  
**Current software name:** Envision AI  
**Release number and version number:** 1  
**Test Type:** Conventional Testing  
**Reported By:** Atharva Munshi

**Reported Date:** 11 April 2020  
**Test\_case\_ID:** E\_07  
**Feature Name:** Text detection  
**Problem severity:** Major

**Problem summary:**

The application is not able to detect handwritten large size hindi text properly.

**How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the document which has the handwritten text. The text size should be too large.

Step 5: The envision app doesn't detect the large size hindi text successfully and thus the issue is replicated.

#### **4.2.3 Small size Text (Hindi) Detection**

**Problem ID:** ENV\_BUG\_03  
**Current software name:** Envision AI  
**Release number and version number:** 1  
**Test Type:** Conventional Testing  
**Reported By:** Atharva Munshi  
**Reported Date:** 11 April 2020  
**Test\_case\_ID:** E\_08  
**Feature Name:** Text detection  
**Problem severity:** Major

**Problem summary:**

The application is not able to detect handwritten small size hindi text properly.

**How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the document which has the handwritten text. The text size should be too large.

Step 5: The envision app doesn't detect the small size hindi text successfully and thus the issue is replicated.

#### **4.2.4 Optimal size hindi text detection**

**Problem ID:** ENV\_BUG\_04

**Current software name:** Envision AI

**Release number and version number:** 1

**Test Type:** Conventional Testing

**Reported By:** Atharva Munshi

**Reported Date:** 11 April 2020

**Test\_case\_ID:** E\_09

**Feature Name:** Text detection

**Problem severity:** Major

##### **Problem summary:**

The application is not able to detect handwritten optimal size hindi text properly.

##### **How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the document which has the handwritten text. The text size should be too large.

Step 5: The envision app doesn't detect the optimal size hindi text successfully and thus the issue is replicated.

#### 4.2.5 Color detection Functionality

**Problem ID:** ENV\_BUG\_05  
**Current software name:** Envision AI  
**Release number and version number:** 1  
**Test Type:** Conventional Testing  
**Reported By:** Atharva Munshi  
**Reported Date:** 11 April 2020  
**Test\_case\_ID:** E\_04  
**Feature Name:** Color Detection  
**Problem severity:** Major

##### **Problem summary:**

The application is not able to detect secondary color (Green) properly

##### **How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the secondary color (Green)

Step 5: The envision app doesn't detect the secondary color and thus the issue is replicated.

#### 4.2.6 Color detection Functionality

**Problem ID:** ENV\_BUG\_06  
**Current software name:** Envision AI  
**Release number and version number:** 1  
**Test Type:** Conventional Testing  
**Reported By:** Atharva Munshi  
**Reported Date:** 11 April 2020  
**Test\_case\_ID:** E\_06  
**Feature Name:** Color Detection  
**Problem severity:** Major



**Problem summary:**

The application is not able to detect secondary color (Purple) properly

**How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the secondary color (Purple)

Step 5: The envision app doesn't detect the secondary color and thus the issue is replicated.

**4.2.7 Color detection Functionality**

**Problem ID:** ENV\_BUG\_07

**Current software name:** Envision AI

**Release number and version number:** 1

**Test Type:** Conventional Testing

**Reported By:** Atharva Munshi

**Reported Date:** 11 April 2020

**Test\_case\_ID:** E\_08,E\_09,E\_10

**Feature Name:** Color Detection

**Problem severity:** Major

**Problem summary:**

The application is not able to detect tertiary color (red-orange, red-purple,yellow green) properly

**How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the tertiary color

Step 5: The envision app doesn't detect the tertiary color and thus the issue is replicated.

#### **4.2.8 Object/Face detection Functionality**

**Problem ID:** ENV\_BUG\_08

**Current software name:** Envision AI

**Release number and version number:** 1

**Test Type:** Conventional Testing

**Reported By:** Atharva Munshi

**Reported Date:** 11 April 2020

**Test\_case\_ID:** E\_02

**Feature Name:** Object/Face detection

**Problem severity:** Major

##### **Problem summary:**

The application is not able to detect Object properly

##### **How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on multiple objects.

Step 5: The envision app doesn't detect multiple objects successfully and thus the issue is replicated.

#### 4.2.9 Object/Face detection Functionality

**Problem ID:** ENV\_BUG\_09  
**Current software name:** Envision AI  
**Release number and version number:** 1  
**Test Type:** Conventional Testing  
**Reported By:** Atharva Munshi  
**Reported Date:** 11 April 2020  
**Test\_case\_ID:** E\_03  
**Feature Name:** Object/Face detection  
**Problem severity:** Major

##### **Problem summary:**

The application is not able to detect the gender and activity of a standing person properly.

##### **How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on male who's standing.

Step 5: The envision app is not able to detect the gender and activity of a standing person properly and thus the issue is replicated.

#### 4.2.10 Object/Face detection Functionality

**Problem ID:** ENV\_BUG\_10  
**Current software name:** Envision AI  
**Release number and version number:** 1  
**Test Type:** Conventional Testing  
**Reported By:** Atharva Munshi  
**Reported Date:** 11 April 2020  
**Test\_case\_ID:** E\_05  
**Feature Name:** Object/Face detection

**Problem severity:** Major

**Problem summary:**

The application is not able to detect the gender and activity of a walking person properly.

**How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on male who's walking.

Step 5: The envision app is not able to detect the gender and activity of a walking person properly and thus the issue is replicated.

#### **4.2.11 Object/Face detection Functionality**

**Problem ID:** ENV\_BUG\_11

**Current software name:** Envision AI

**Release number and version number:** 1

**Test Type:** Conventional Testing

**Reported By:** Atharva Munshi

**Reported Date:** 11 April 2020

**Test\_case\_ID:** E\_06

**Feature Name:** Object/Face detection

**Problem severity:** Major

**Problem summary:**

The application is not able to detect the gender and activity of a Playing person properly.

**How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on male who's Playing.

Step 5: The envision app is not able to detect the gender and activity of a Playing person properly and thus the issue is replicated.

#### **4.2.12 Barcode detection Functionality**

**Problem ID:** ENV\_BUG\_12

**Current software name:** Envision AI

**Release number and version number:** 1

**Test Type:** Conventional Testing

**Reported By:** Atharva Munshi

**Reported Date:** 11 April 2020

**Test\_case\_ID:** E\_02, E\_05

**Feature Name:** Barcode detection

**Problem severity:** Major

##### **Problem summary:**

The application is not able to detect the Scanned barcode properly.

##### **How to reproduce?**

Step1: Connect mobile to Wifi network.

Step2: Installation of Envision AI app is needed.

Step 3: Log into the application

Step 4: Place the camera on the barcode.

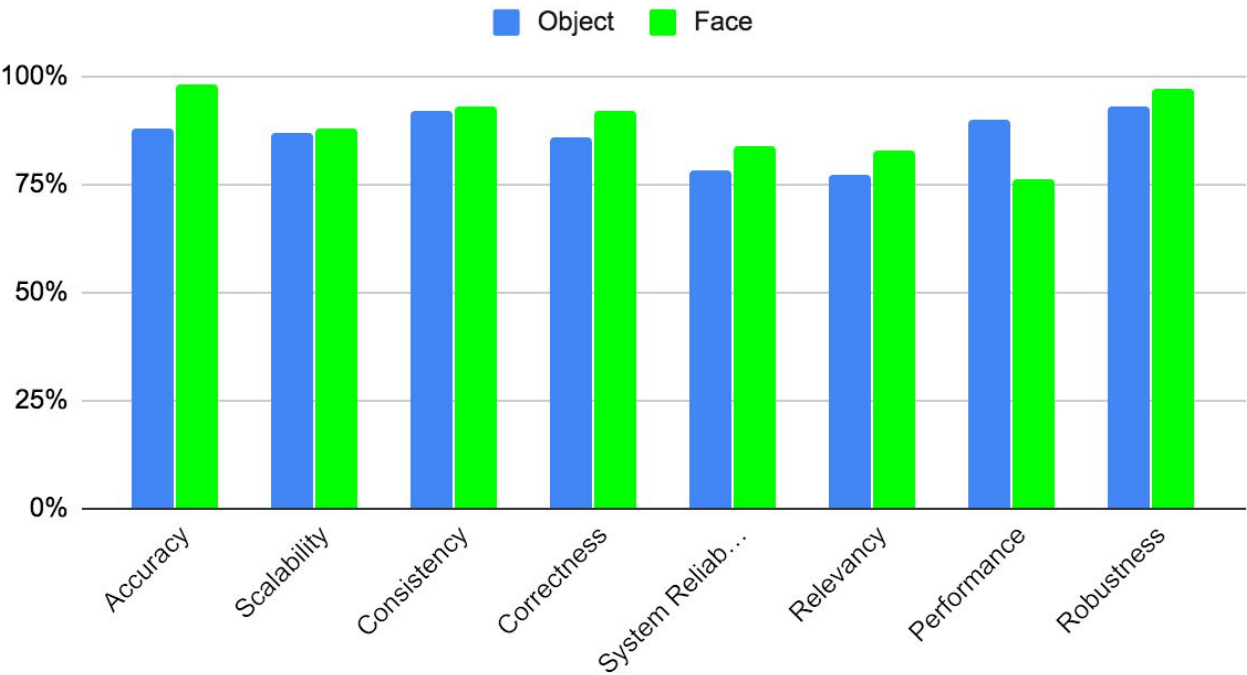
Step 5: The envision app is not able to detect the blurred barcode properly and thus the issue is replicated.

#### **4.3 AI function test quality assessment**

4.3.1 Test Quality Assessment for Object/Face Detection feature

	Accuracy	Scalability	Consistency	Correctness	System Reliability	Relevancy	Performance	Robustness
Object	88%	87%	92%	86%	78%	77%	90%	93%
Face	98%	88%	93%	92%	84%	83%	76%	97%

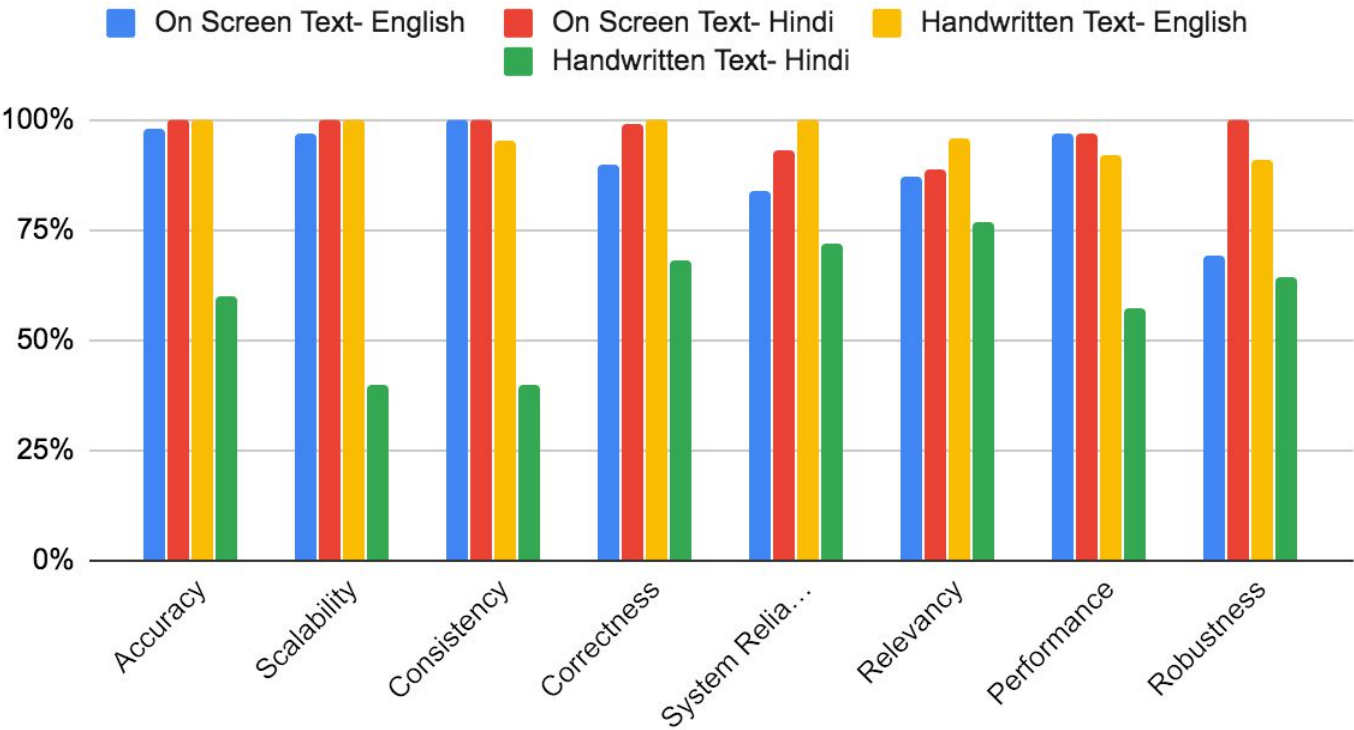
Test Quality Assessment for Object/Face Detection feature



4.3.2 Test Quality Assessment for Text Detection feature

	Accuracy	Scalability	Consistency	Correctness	System Reliability	Relevancy	Performance	Robustness
On Screen Text- English	98%	97%	100%	90%	84%	87%	97%	69%
On Screen Text- Hindi	100%	100%	100%	99%	93%	89%	97%	100%
Handwritten Text- English	100%	100%	95%	100%	100%	96%	92%	91%
Handwritten Text- Hindi	60%	40%	40%	68%	72%	77%	57%	64%

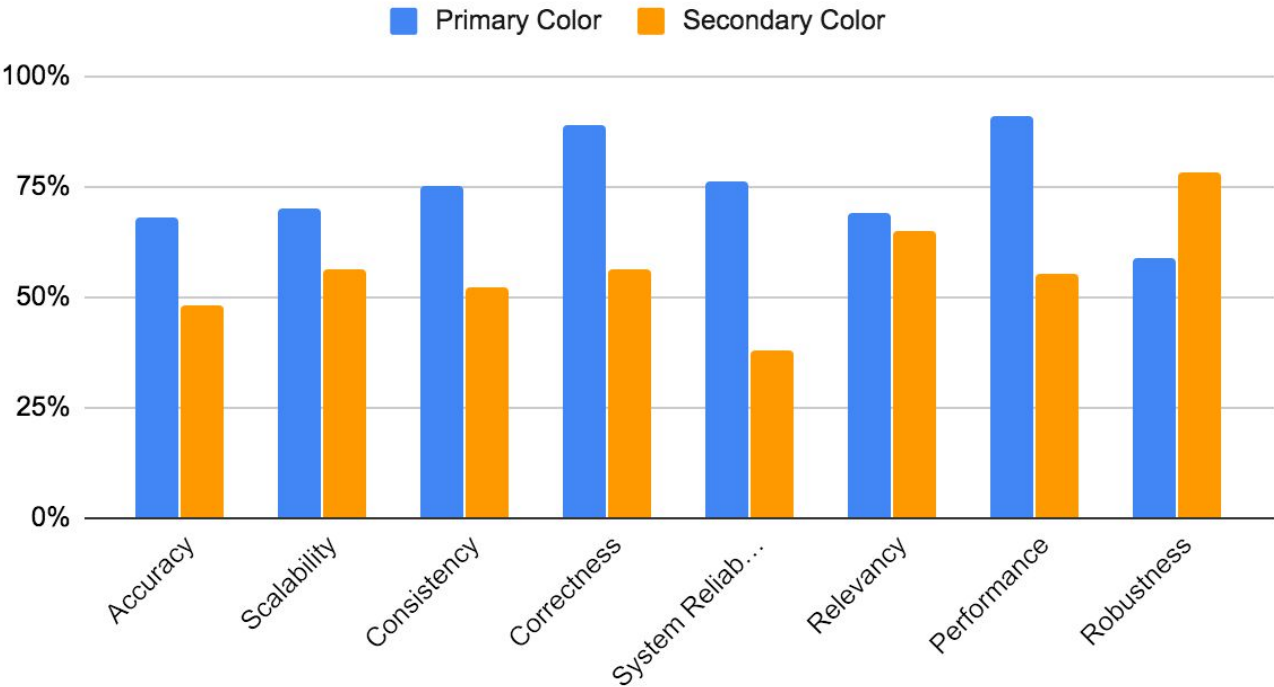
Test Quality Assessment for Text Detection feature



4.3.3 Test Quality Assessment for Color Identification feature

	Accuracy	Scalability	Consistency	Correctness	System Reliability	Relevancy	Performance	Robustness
Primary Color	68%	70%	75%	89%	76%	69%	91%	59%
Secondary Color	48%	56%	52%	56%	38%	65%	55%	78%

Test Quality Assessment for Color Identification feature





4.3.4 Test Quality Assessment for Barcode Scan feature

	Accuracy	Scalability	Consistency	Correctness	System Reliability	Relevancy	Performance	Robustness
Physical Barcode	85%	85%	80%	77%	82%	88%	94%	99%
On Screen Barcode	90%	89%	95%	89%	91%	100%	92%	97%

Test Quality Assessment for Barcode Scan feature

