Course of Designing Mechatronic systems

Final report

UNIVERSITÀ DEGLI STUDI DI BRESCIA

SORBONNE UNIVERSITÉ

Tshirt colour sorting for Blind People

Students: **Milanesi Marco**
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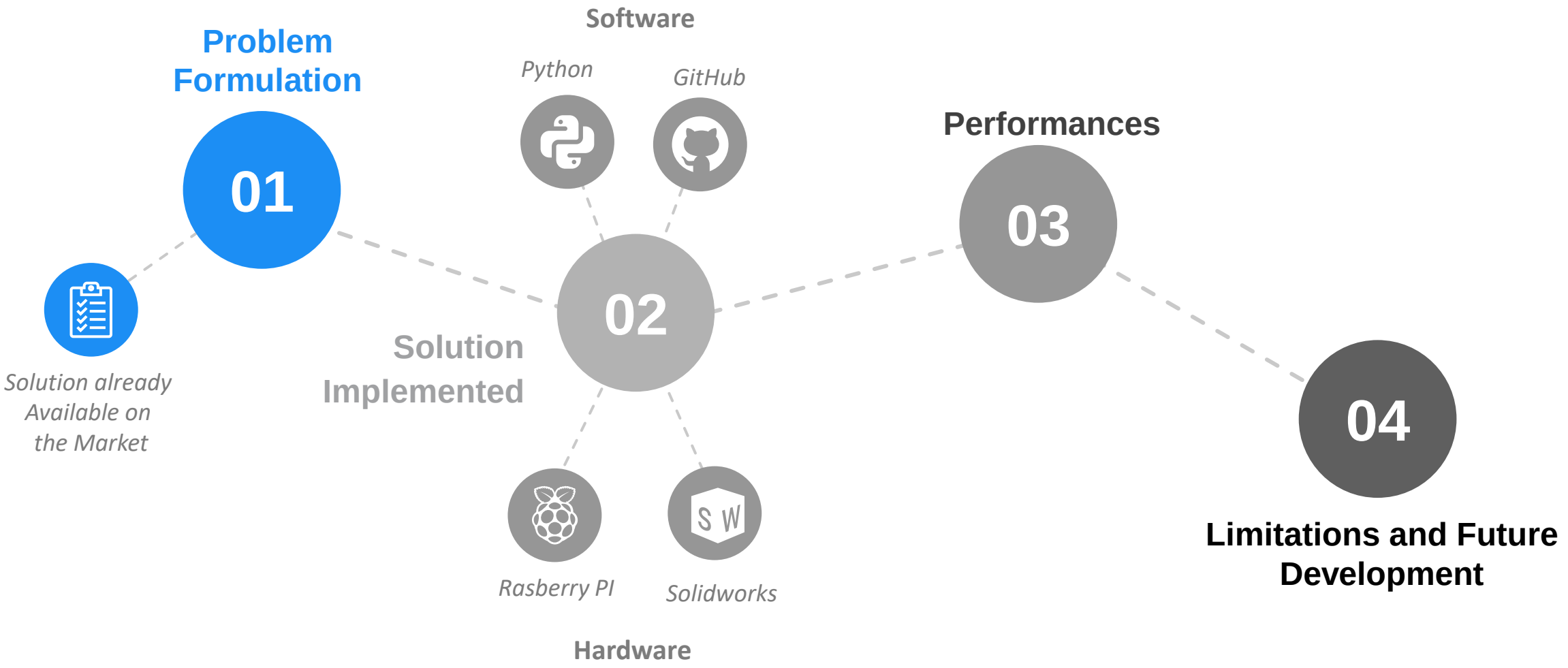
Supervisor: **Fabien Verité**

2022-2023

Project Phases

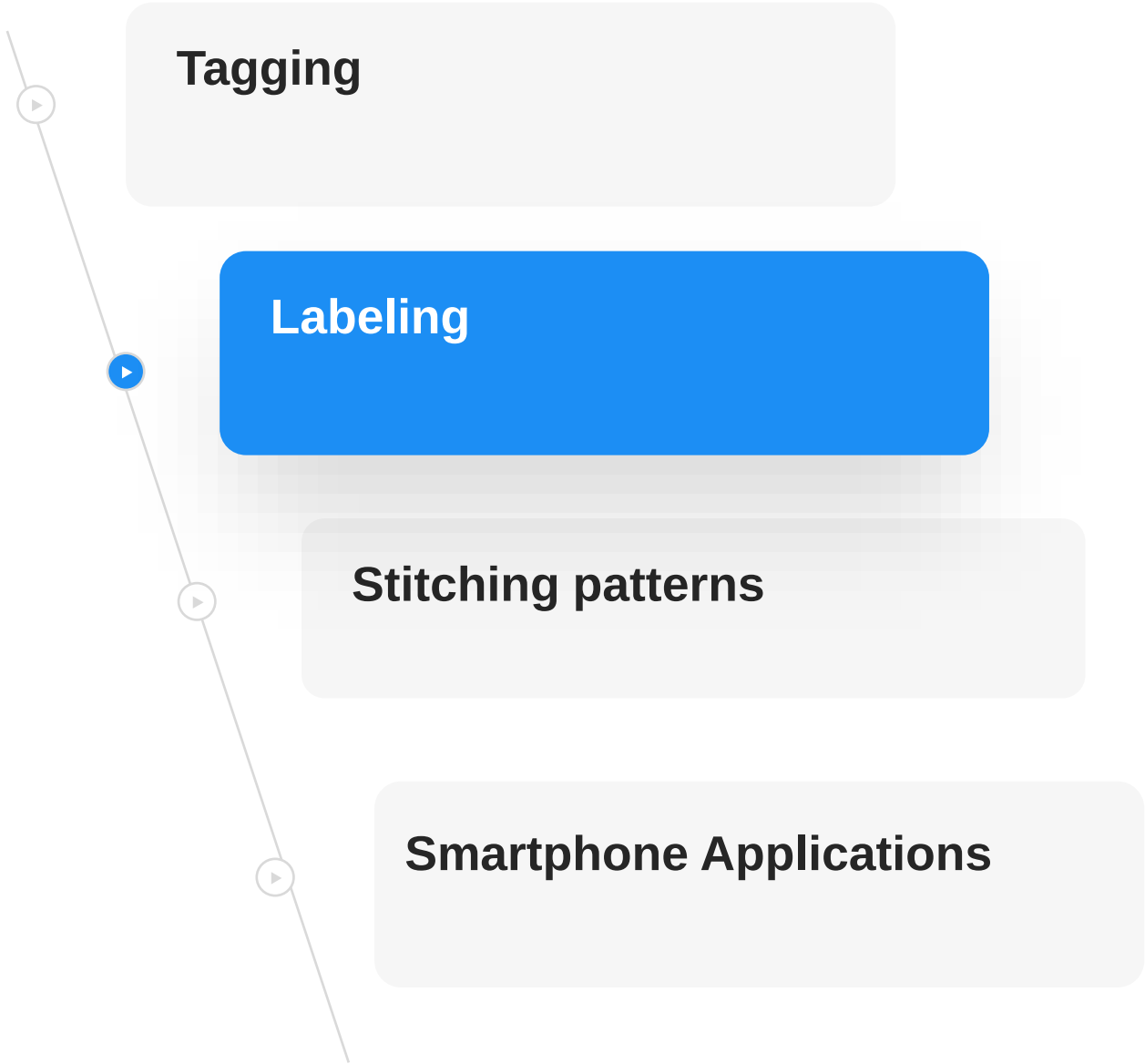


Contents

Problem Formulation and Existing solutions

Visual impairment and Daily tasks

- *Blind people need to recognize their clothing in a daily basis.*
- *Visual impairment should not be a limitation for this task.*
- *Many solutions are already implemented but based on touch sensitivity*



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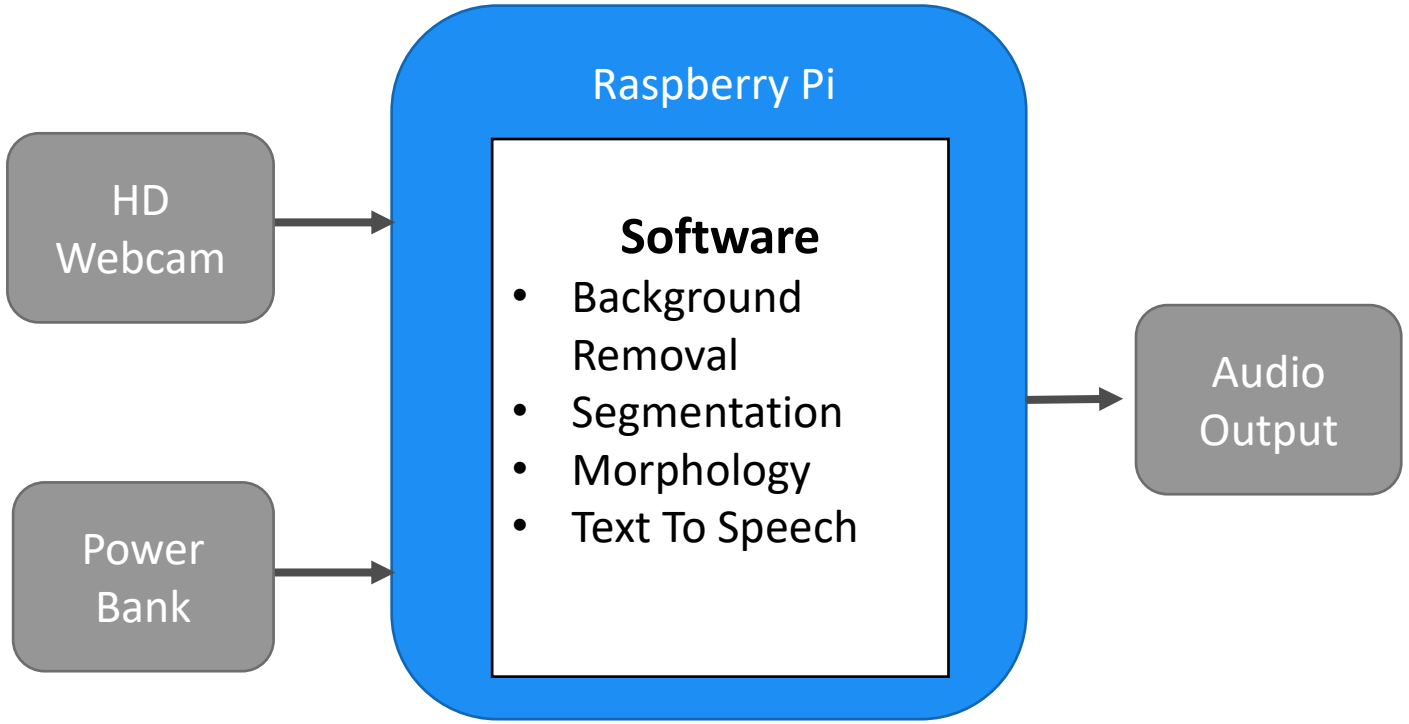
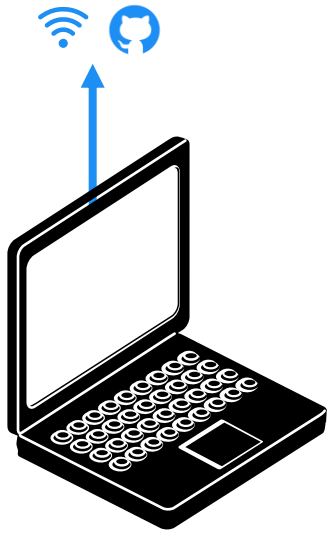
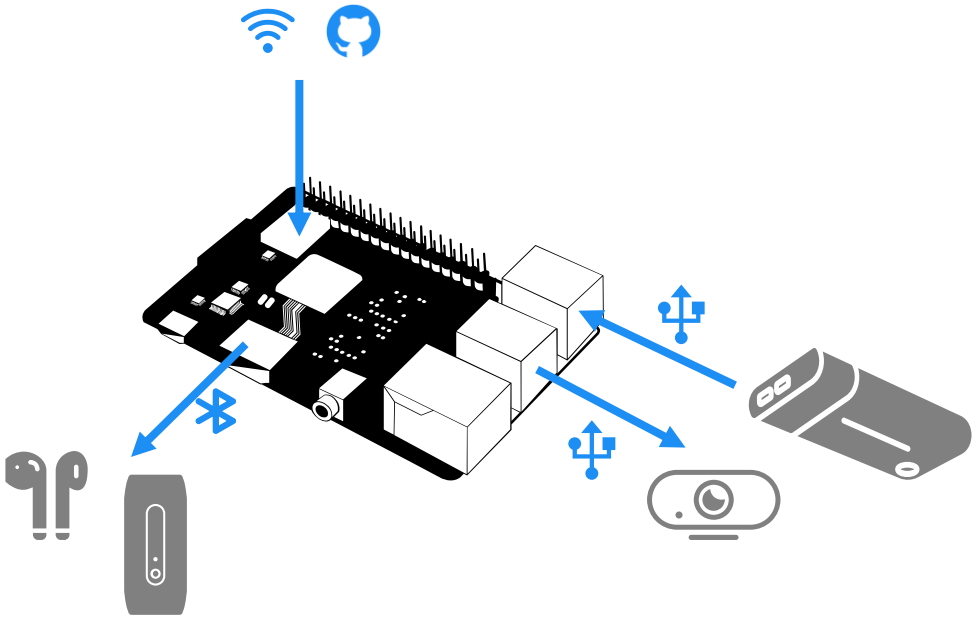
Solution Implemented

Block Scheme







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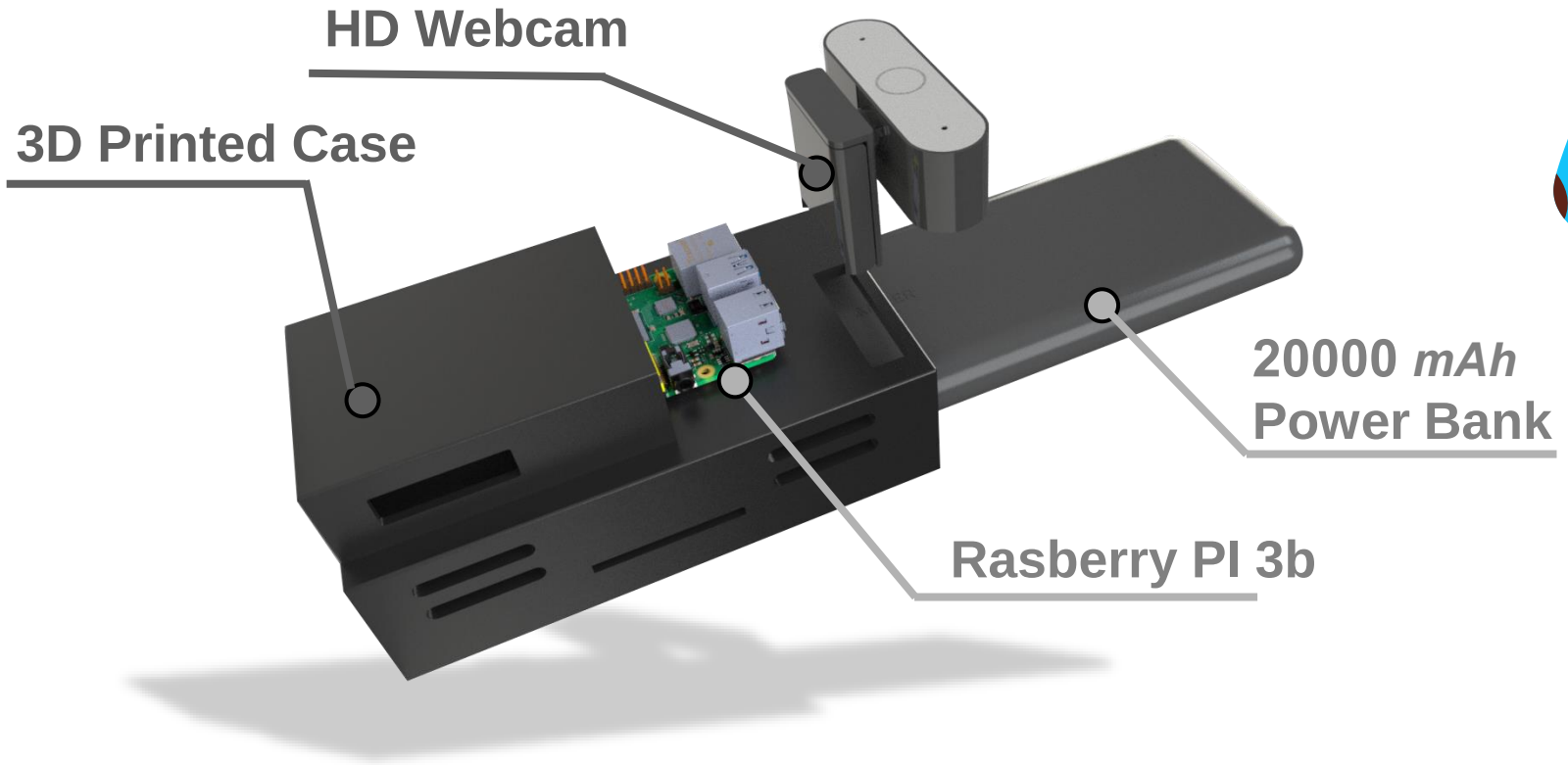
Implemented Solution

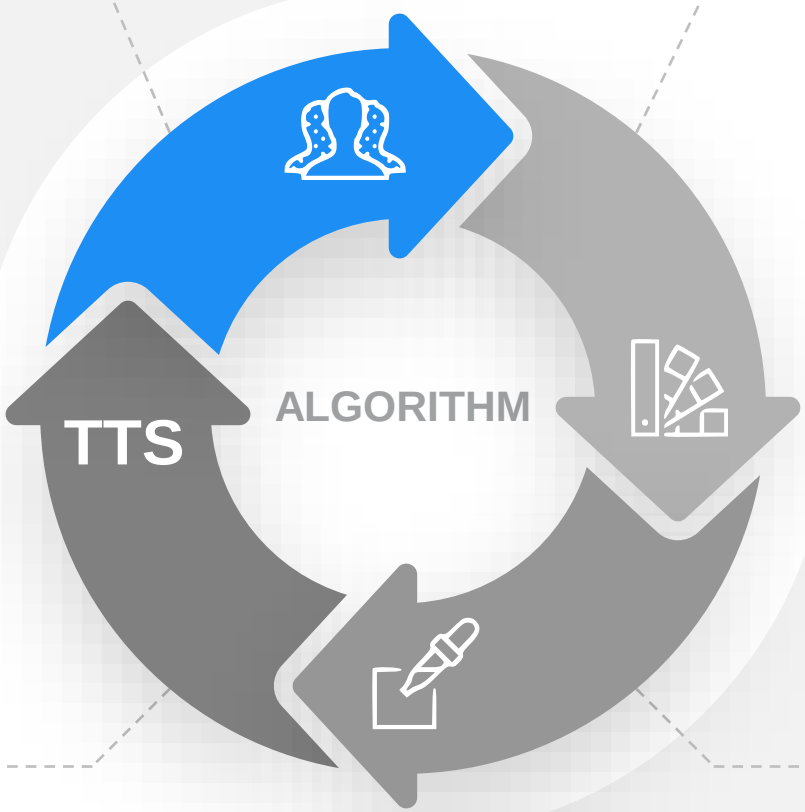


1) Background Removal – Morphological Operations

It gives the condition to start the segmentation and prevent to recognize the background as a thsirt

2) Segmentation

Segmentation between the 2 colors selected for the competition through HSV values



4) Text to Speech

based on the tshirt already present on the hanger and the new sorting the audio command is reproduced

3) Color and Brightness Sorting

Brightness is evaluated through RGB values

$$L = \sqrt{0.241R^2 + 0.691G^2 + 0.068B^2}$$

1) Background Removal and Morphological Operations

1.1

Input Video

1.2

Background Removal

1.3

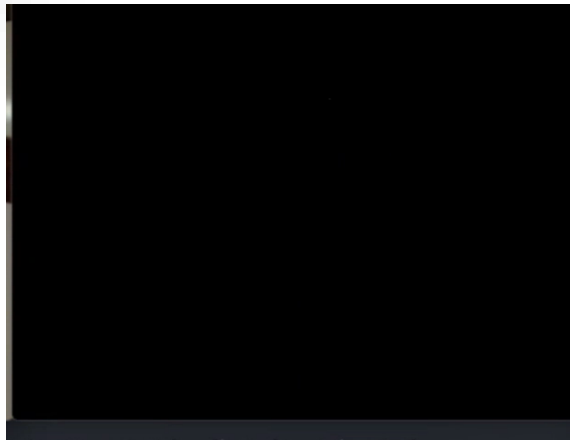
Morphological Operations

2) Segmentation

Input Video

2.1

Background Removal

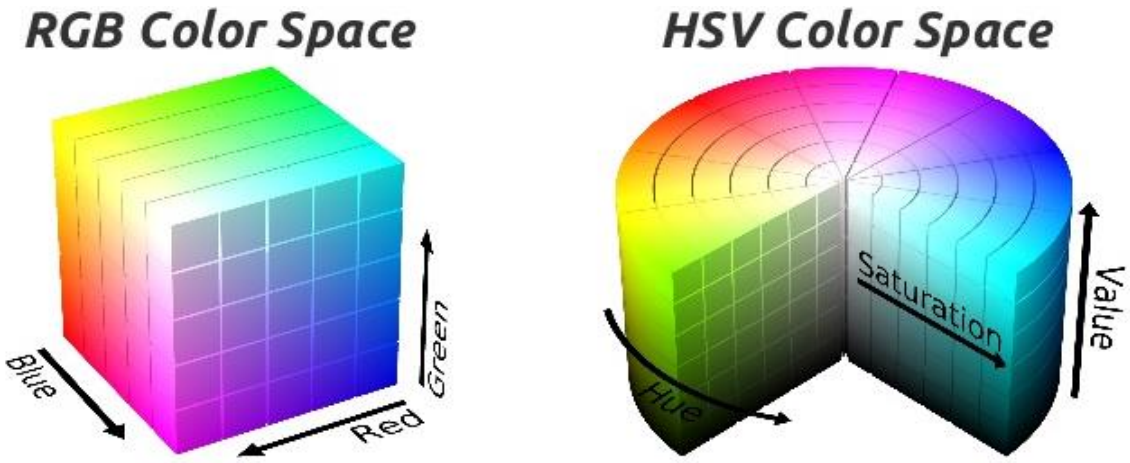


Color 1

Color 2

Segmentation

3) Color and Brightness Sorting



$$brightness = \sqrt{a \times R^2 + b \times G^2 + c \times B^2}$$

$$a = 0.241 \qquad b = 0.691 \qquad c = 0.068$$

HSV colour space *to distinguish between different colours*

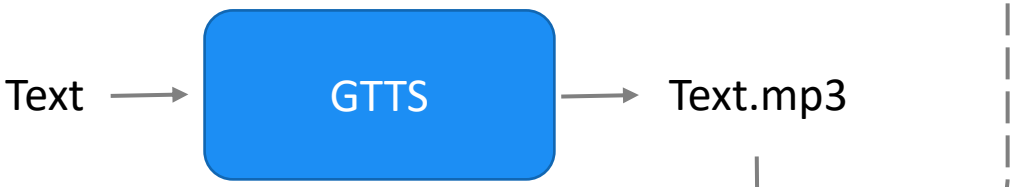
RGB colour space *to evaluate brightness since:*

- *more accurate representation of perceived brightness*
- *it takes into account the non-uniform sensitivity of the human eye*

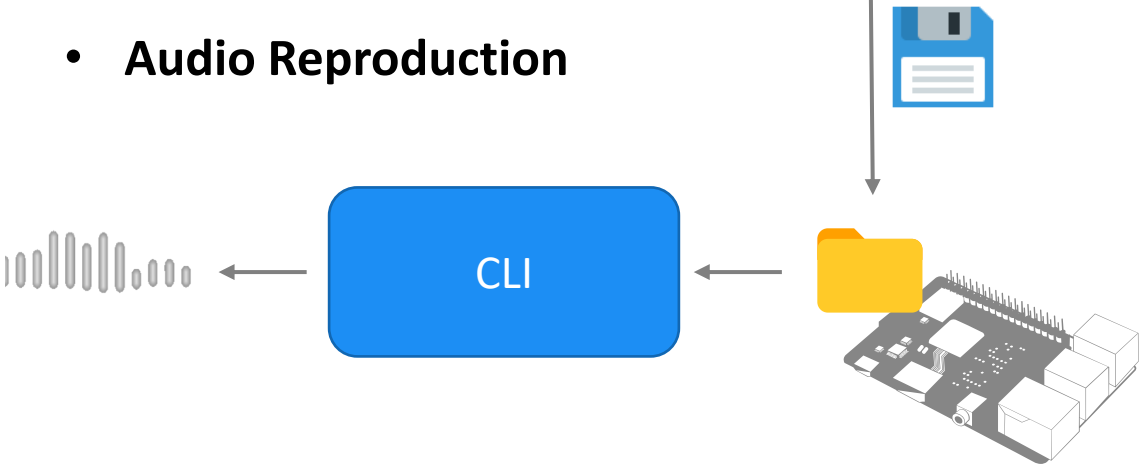
4) Text to Speech

Generated Previously

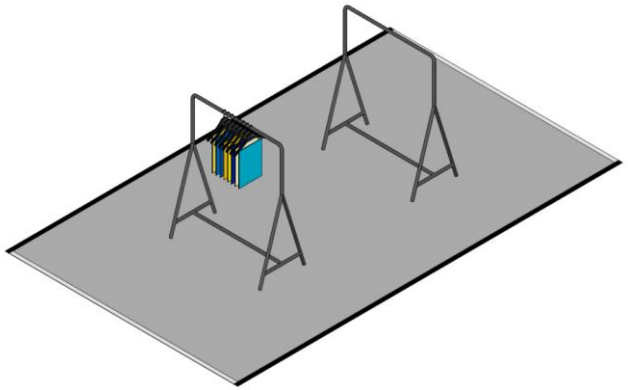
- **Audio Generation**

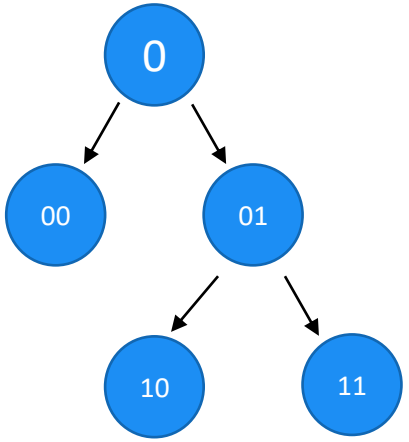


- **Audio Reproduction**



- **Make Sentence based on system state**





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Obtained results

Perfomances	Results
Number of Trained User	$4\ Users$
Number of Test for each user	$5\ Tests$ on $6\ Tshirts$
Accuracy on Colors	$100\ \%$
Accuracy on Brightness	$85\ \%$
Time needed	$4{,}30\ minutes\ \pm 51\ seconds$

Characteristics and Main Advantages

Characteristic	Value
Weight	500 g
Battery	**$20000mAh$**
Dimensions	90 x 200 mm
Camera Resolution	1080p
Material	PLA

- **Offline solution**
- **Stand Alone Solution**
- **High Autonomy ($\approx$ 24h)**
- **Cheap Component Costs ($\approx$ 80 €)**
- **Easy Implementation**

Contents

Limitation

Vision System with WebCam

Segmentation

Background removal fails to detect the T-shirt if too close, because of luminosity incoherence.

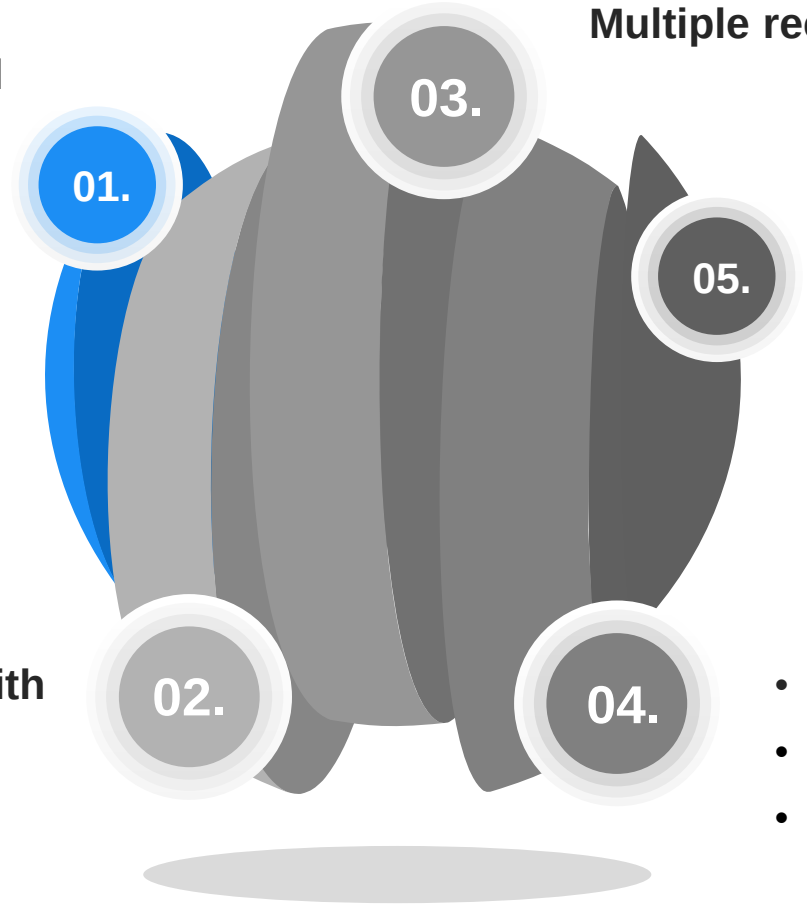
Brightness Identification

Luminosity in the environment must be controlled.

Future works

Normalization of enviromental conditions through image processing

Multiple recognition to be Faster



Increase computational performance:

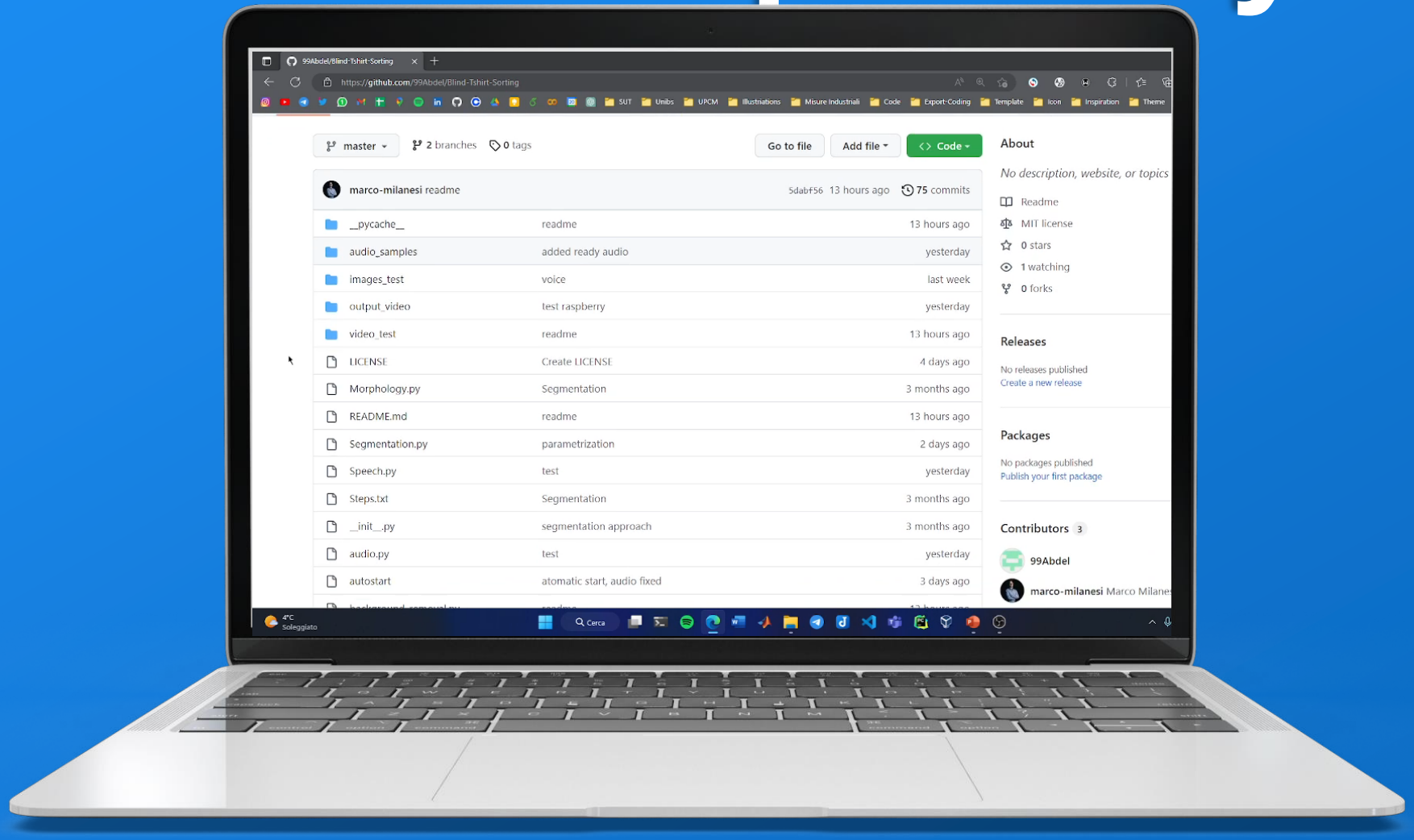
- Board swap is Easy (Jetson Nano)
- Exploration of other sorting algorithm

AND/OR Equip the device with a flash

- Color sensor
- More interaction with user
- Lighter power bank

99Abdel/Blind-Tshirt-Sorting (github.com)

Github Repository



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Thanks for your attention.

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Video Test