Octane'22 Review Presentation

Project : Pad printing Machine Vision inspection system in Wheel

Department : MTD R&A (Engineering)

Mentor : Pravin Marathe Sir

BU-HR : Abhipsa Das

Overview

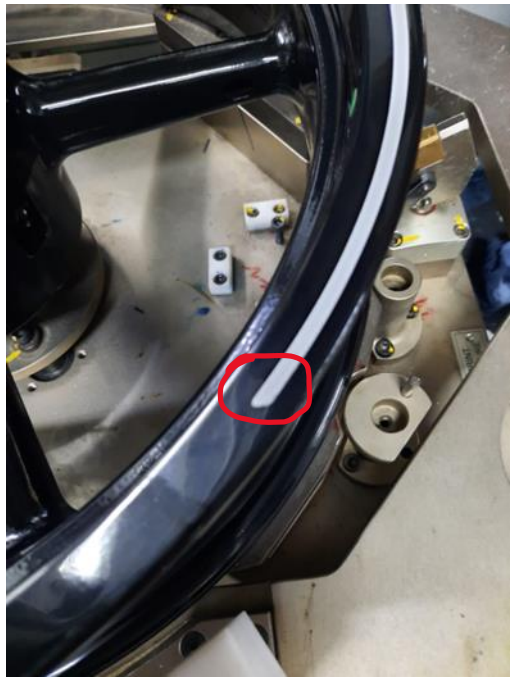
Project Title	Why this project?	How will it impact the overall goal of the Department / BU?	Project Objective	Target	Key Deliverables
Pad printing Machine Vision inspection system in Wheel	Good exposure of Computer Vision applications in the automotive industry, using edge computing with Jetson Nano along with Hands on experience with python programming	(1) Automation of visual inspection systems (2) Quality improvement (3) Better Reliability (4) Digitalizing the processes	Identifying the defects in wheel pad printing	July 15th	Develop Vision Application software for printing defects detection using Computer Vision.

Pad Printing

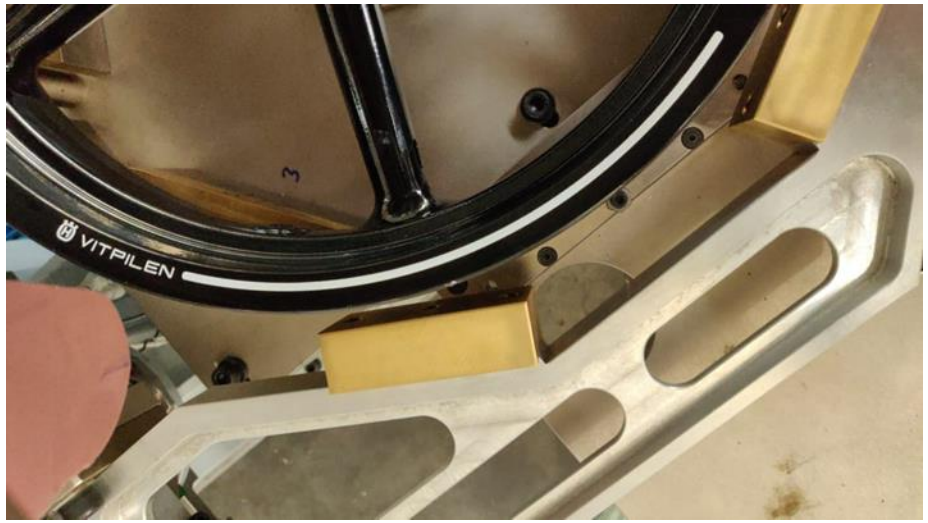
- Pad printing is a printing process that can transfer a 2-D image onto a 3-D object.
- Pad printing is used in automotive industry.
- Indicator parts, Dashboard components, **Wheels** etc.

- **What are the possible defects in pad printing?**
    1. Print cut
    2. Print shift
    3. Partial print
    4. Double print
    5. Print edge burr
    6. Print smudging

Possible Pad Printing Defects



Print Cut



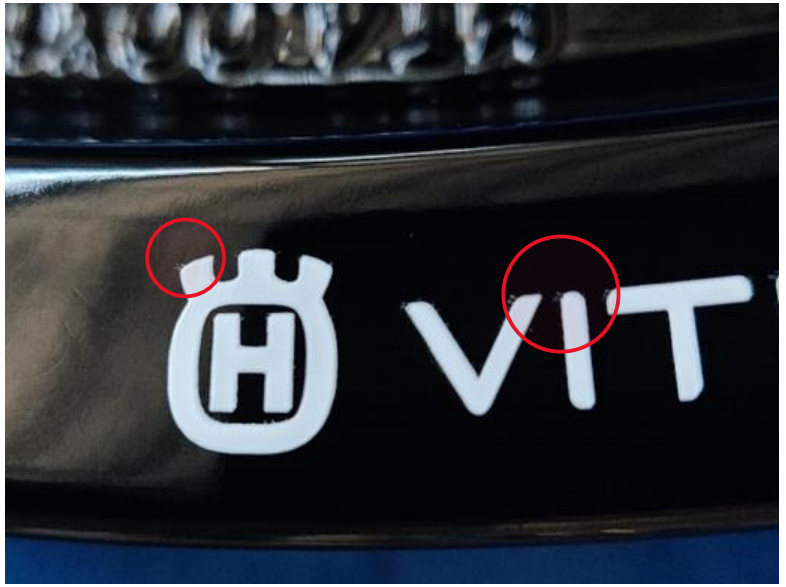
Print shift

Partial print

Possible Pad Printing Defects

Double print

Print
Smudging



Print Edge burr

Machine Vision Inspection System

- Vision inspection systems provide image-based inspection automated for your convenience for a variety of industrial and manufacturing applications.
- 2D machine vision system is used.
- Major components : Lighting, lens, image sensor.
- **Benefits:**
    1. **Lowers Costs**
    2. **Eliminates Human Error**
    3. **Identifies Print Defects**
    4. **Low inference time**
    5. **Reliability**
    6. **Simple Layout**

Vision system Camera

- For identifying defects using OpenCV, camera used can be of low resolution
- For identifying defects using Machine learning, camera of high resolution should be used.

Bassler acA2500-14uc

- Sensor : MT9P031
- Shutter : Rolling Shutter
- Sensor Type: CMOS
- Sensor Size : 5.7 mm x 4.3 mm
- Resolution : 5 MP
- Frame Rate : 14 fps

Logitech C270

- Sensor Type : CMOS
- Resolution : 720p
- Frame rate : 30 fps

Approach towards identifying defects

- Print shift
- Print Cut
- Double print

OpenCV

- Partial print
- Print smudging
- Print edge burr
- Other defects like scratches, dust etc

Machine Learning

Image Pre-processing

Image	Thresholding	Edge detection	Morphological Transformation	Masked image	Bitwise operation

- To improve the quality of the image so that we can analyze it in a better way.
- After pre-processing, template matching technique is used to find the defects.
- Programming Language used: Python
- Libraries used : OpenCV, NumPy, matplotlib

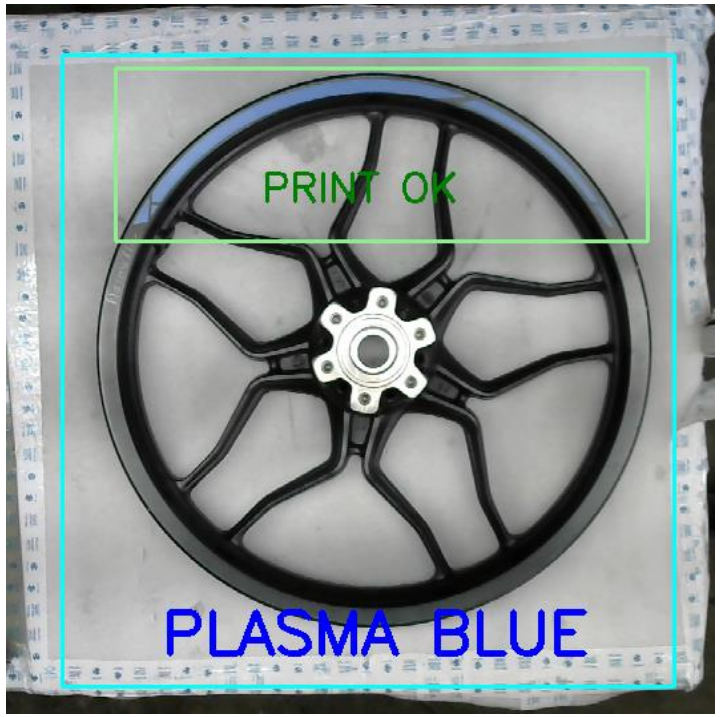
Defect Identification – OpenCV

- **OpenCV** is an open-source computer vision library
- **Template matching** is a technique in vision image processing for finding small parts of an image which match a template image.

Template for this image

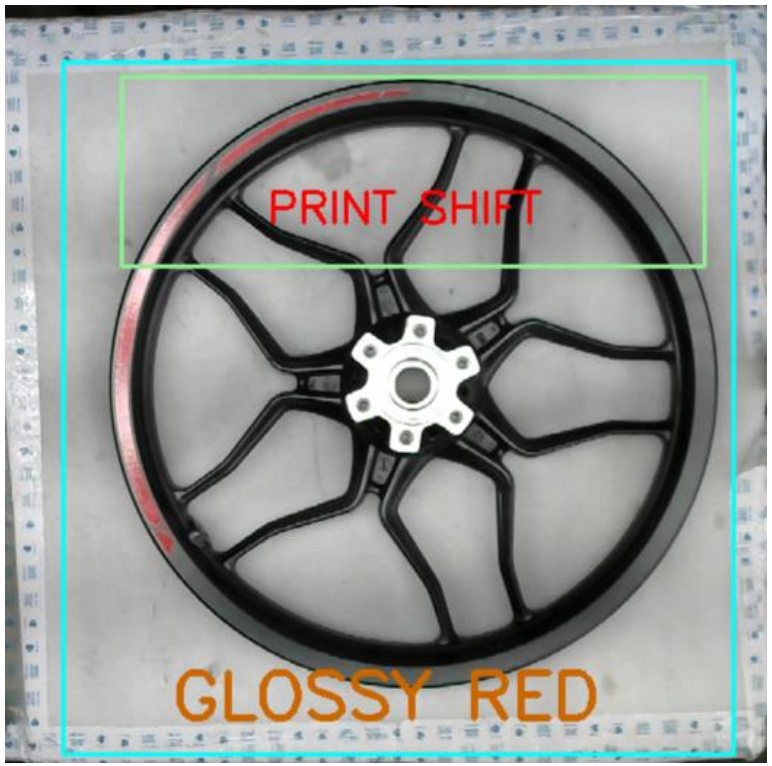
Print Shift

- Three models were given for identification. Results are as shown:



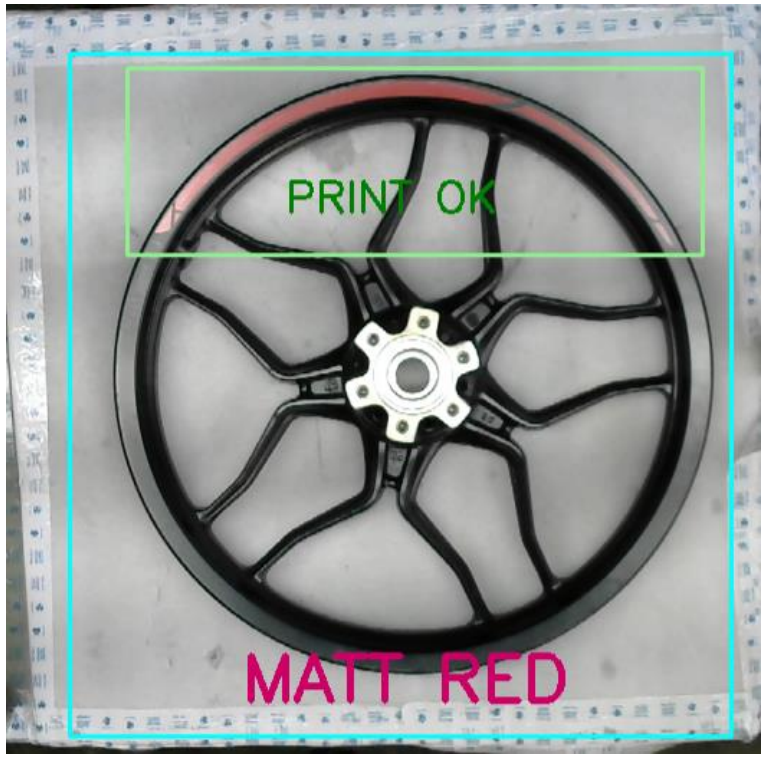
MODEL: PLASMA BLUE

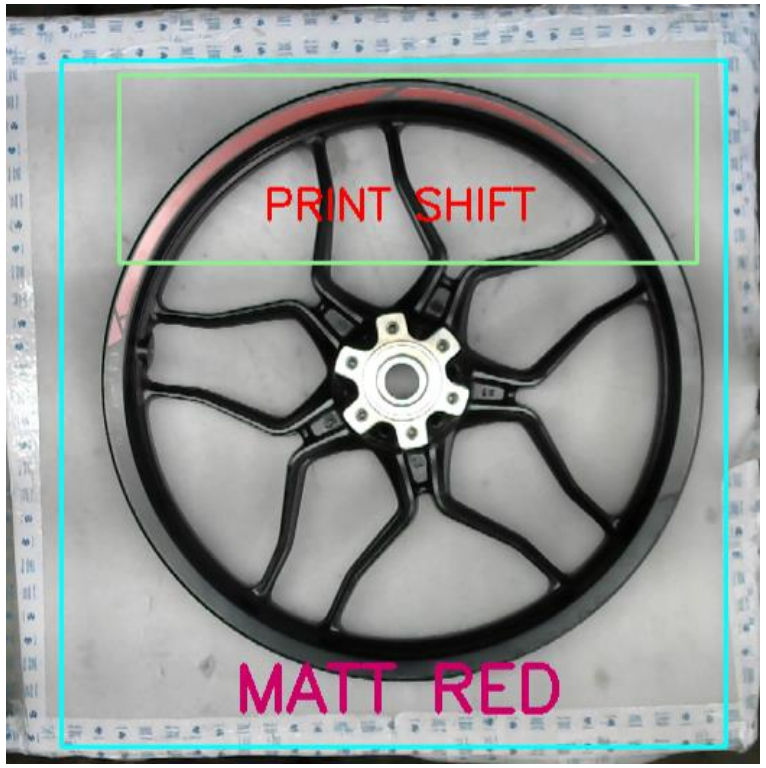
Print shift

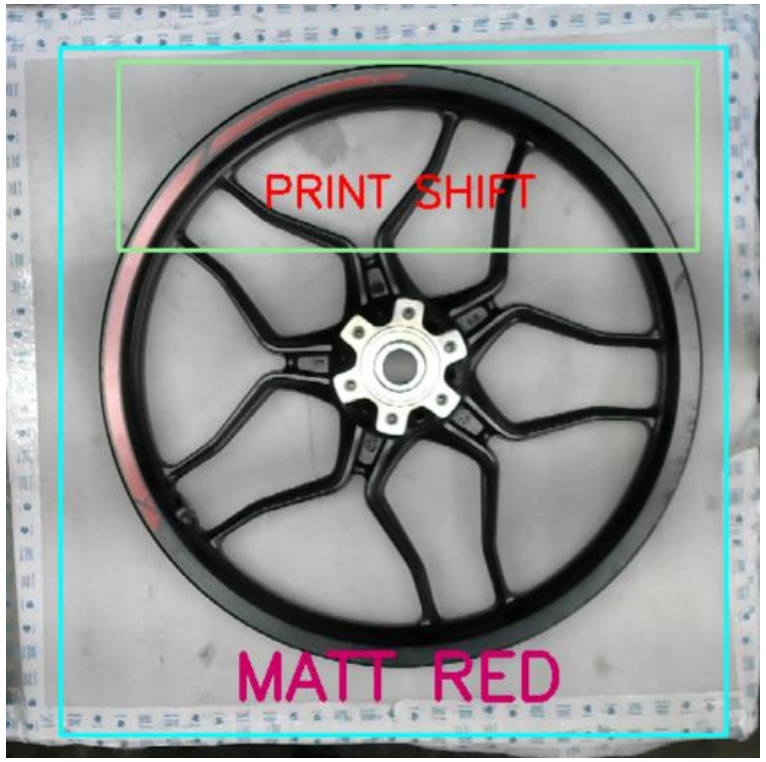


MODEL: GLOSSY RED

Print shift







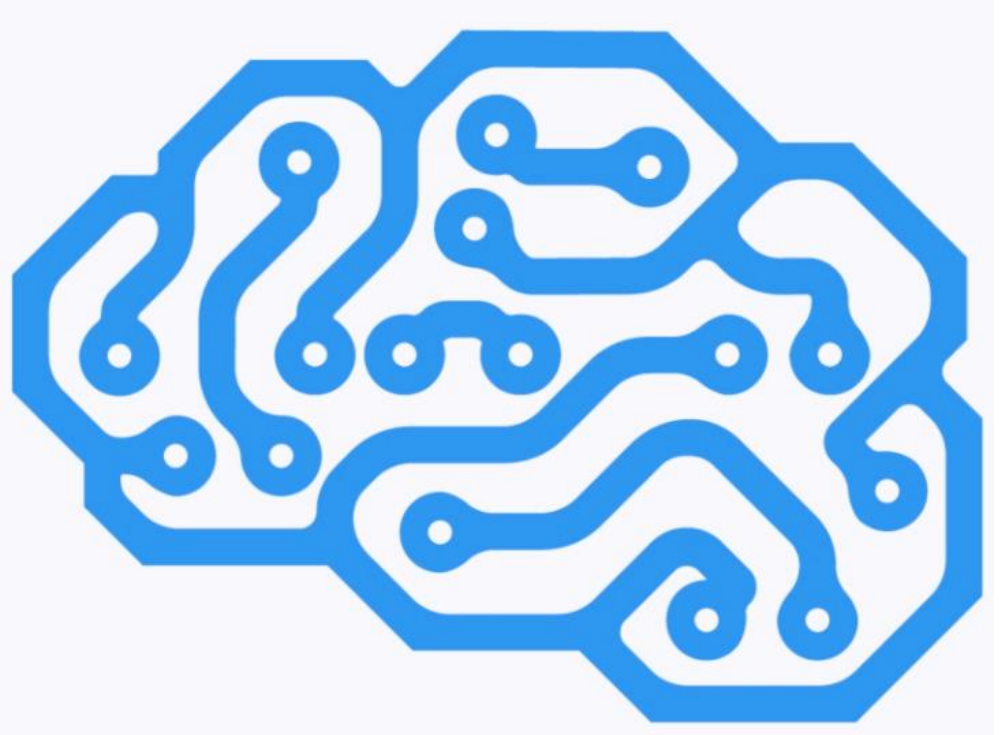
MODEL: MATT BURNT RED

Defect Identification - Machine Learning

- The models are provided with training and testing data and the features to be identified are defined.

- **But why ML for this?**

There are so many variables that we can't contain. We never know what kind of error comes up and it is not always a single kind of error.



Timeline

Timeline (8 Weeks)							
Week 1	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**	**Week 8**
1) Acquainted with computer vision and its uses in image applications 2) Studied python and various libraries used like OpenCV 3) Studied about Jetson Nano	1) Worked on OpenCV 2) Experimented with a bearing to test my understanding on OpenCV. 3) Implemented most of the functions in the library and detected features of it.	1) Given rims of three models for identification 2) Identified the type of model and detected a particular type of defect – Print Shift	1) Working on other defects using OpenCV 2) Studying deep learning models 3) Choosing a model suitable for the detection for each defect	1) Model training 2) Patterns and predictions to be made 3) Different predictions for different models	1) Evaluating the models 2) Increasing the accuracy of the models 3) Finding the speed and try to optimize it	1) Parameter tuning 2) All the variables to be fine tuned to maximize the accuracy of type of defect detected	1) Prediction making 2) If any error, find which part is wrong 3) Make necessary changes if prediction made is wrong

Thank You!