A Study on Image Processing to Facilitate Business System by Multiple Barcode Detection

Ahsanullah University of Science and Technology

Course No: CSE 4100

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We would like to thank sir without whose encouragement, this thesis would have never been accomplished.

INTRODUCTION

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- As a consumer we are familiar with the term **BARCODE**
- We want to work on detecting multiple barcode from images

Why barcode detection is important?

“Where barcode is used in general?

PRODUCT MANAGEMENT

INVENTORY MANAGEMENT

MANUFACTORING

HEALTH CARE

TICKETS


australia
Boarding
8:15 AM
Brisbane
BNE
Perth
PER
Passenger Name
MRS JANE SMITH
Flight
DJ464
Flight Date
18/08/2012
Fare
Economy
Seat
9B
Boarding
Boarding
Boarding
5:50 AM
Cairns
CNS
Fare
Economy
Seat
28F

AIRPORTS


ARRINGTON/FLETCHER
3016UA-314400
ORD 249
ORD


EVA AIR
PVG
CHE/ZOEY
AA 289/26 PVG
AA 307/26 ORD
7001847845
CHINA AIRLINES
TO TAIPEI
TPE 043
P01
HAWAIIAN AIRLINES
BKK/WS12303
PEK TG614
15JUN 10:10
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DIGITAL ADVERTISING


Developers still waiting for tenders to redevelop RRI land in Sungai Buloh

By THEAN LEE CHENG
eecheng@thestar.com.my

TALING JAYA: The race is heating up among erty players gunning for a piece of the awaited redevelopment of the 1,215 ha r Research Institute (RRI) land in Sungai industry sources said.

some property players have present- ideas and many others having regis- erest with the Employees Provident F) – the land-owner and master f the project – the developers have yet to hear of more details or any formal time line being set.

Said a developer: "We have not been

> TURN TO PAGE 2

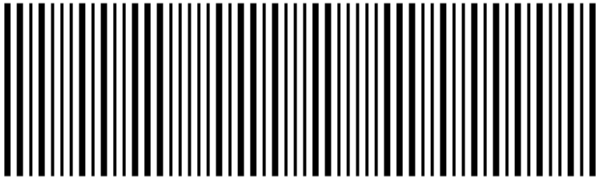
“How barcode is detected usually?

Laser Scanners are most commonly used to read barcodes

TYPES OF BARCODE

BARCODE TYPES

1D barcodes



1234567895

2D barcodes

1D BARCODES

- EAN 13
- UPC
- PostNet
- Bookland

2D barcodes

- QR code
- Maxicode
- Data Matrix

RELATED WORKS

RELATED WORKS

We have followed some papers in which many of them are about image processing, and the rest are about deep learning method such as CNN, YOLO model.

IMAGE PROCESSING BASED WORKS

- Single 1D barcode(EAN-13) analysis was done from a snap of an image using webcam
- BSE method focused on detecting 2D barcodes(QR-curve)
- Angle invariant barcodes (different viewpoint barcode images) detection
- A detection method of a fast color barcode on mobile platform

DEEP LEARNING BASED WORKS

- Detection of 1D(EAN-13) and 2D barcode(QR barcode) using deep learning
- One detector was based on YOLO model
- YOLO model detected barcode and predicted in angle of the barcode
- CNN based detector detected different types of 1D barcodes
- None of the model was unsuccessful in decoding by deep learning

RELATED WORKS

So, we see that some papers worked on single 1D barcode, some on multiple 1D, some worked on just angle invariant barcode. But there is no combination of all these implementations. So, we have merged these operations and add some factors too for the dection and also decoding process.

MOTIVATION

Why we choose barcode detection?

- Automation
- Providing cheaper solution to the sectors use barcodes
- Presenting faster solution to the sectors use barcodes
- Computer Vision, Image recognition research fields might have utilization

PROPOSAL

SINGLE 1D

SINGLE 2D

MULTIPLE 1D

MULTIPLE 1D & 2D

CONDITIONS

CAMERA POSITION

In which angle the barcode is positioned while capturing the image

RESOLUTION

Lower resolution hinders the detection process

SIZE & SHAPE

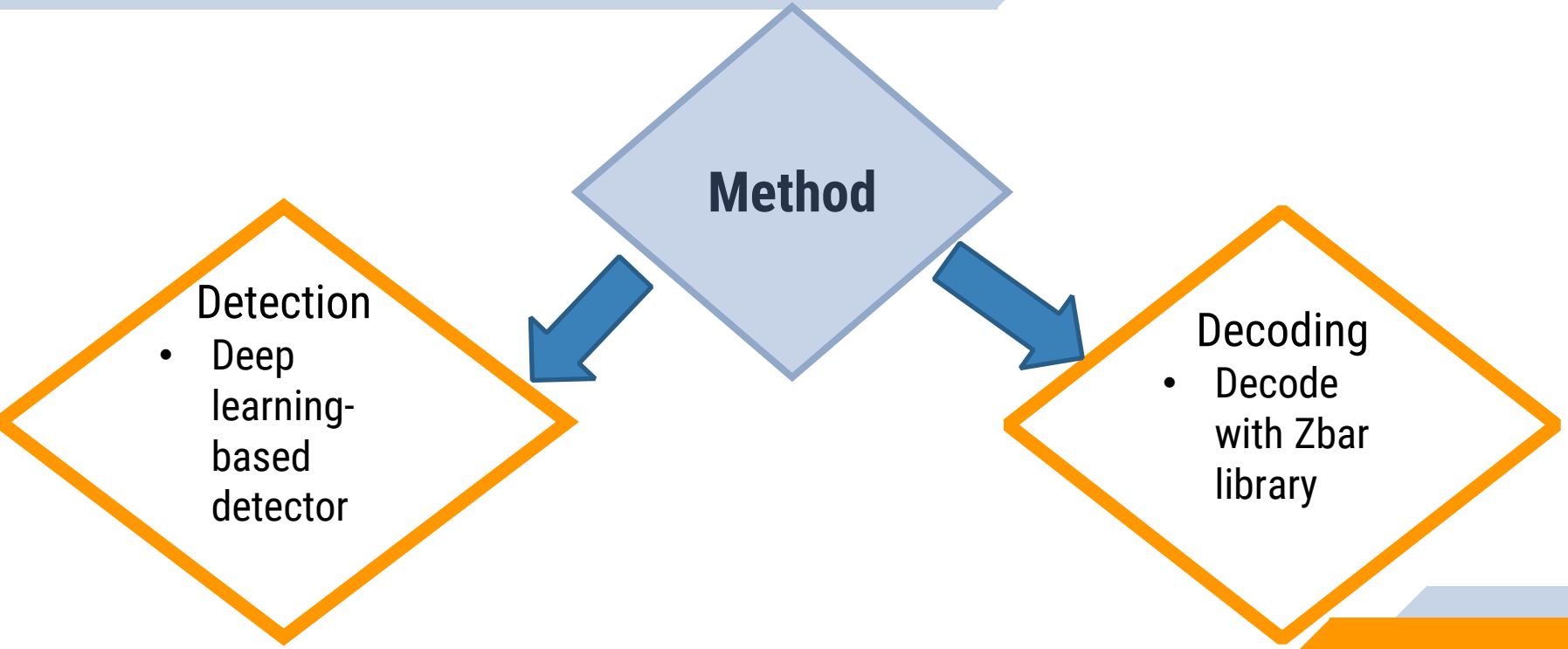
It is difficult to detect the barcode when the shape & size is not usual

PROCESS SIMPLIFIED

Detection → Decode

IMPLEMENTATION

IMPLEMENTATION



Why deep learning-based detector?

- Most efficient library to detect single barcode from image- Zbar library
- Zbar library is deep learning-based library
- First goal is to achieve better detection for multiple barcodes
- To idea was experimented with just one classifier(1D barcode)

Why deep learning-based detector?

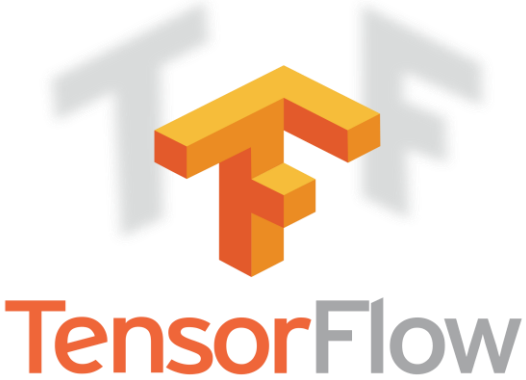
PLATFORMS USED FOR EXPERIMENT

LANGUAGE

- Easy to read language
- Powerful language
- Enriched with libraries

LIBRARIES

- TensorFlow API equipped with existing models



- OpenCV to work with images

- Zbar to decode barcodes

HARDWARE

- Detector was trained on GPU
- Final detector supported by CPU and GPU

TRAINING STEPS FOR DETECTOR

- Data collection
- Model selection
- Test the model

DATA COLLECTION

- Primary source for detection

- Secondary source- Arte-lab dataset for decoding

NUMBER OF OBJECTS

Single objects

Multiple objects

LIGHTING CONDITION

Proper lighting

Dark lighting

BACKGROUND

Simple (white background)

Simple (dark background)

Complex(overlapping)

SHAPE & SIZE

Big and small objects

Square, round , cylindrical

COLOR COMBINATIONS

- Due to unavailability of 2D barcodes we could not add to dataset
- Different combination of 1D barcodes were included
    - black white stipes
    - blue white stripes
    - green white stripes

300 images

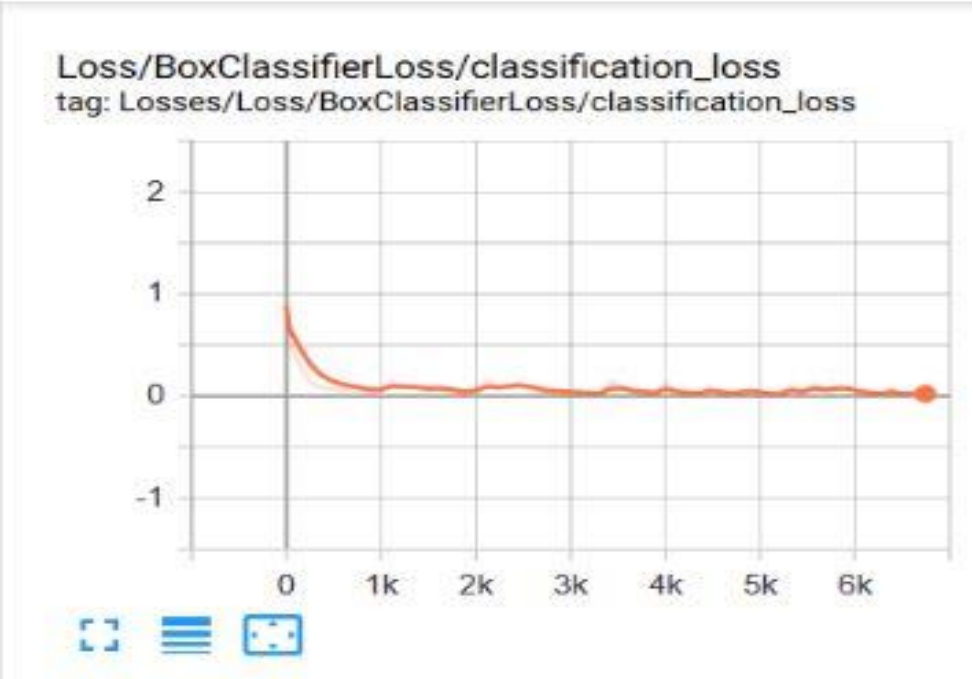
All the images were 1D barcodes it was reduced to lower resolution

MODEL SELECTION

- SSD
  -faster detection
  -less accuracy

- Faster R-CNN
  -slower detection
  -more accuracy

TRAINNING THE MODEL

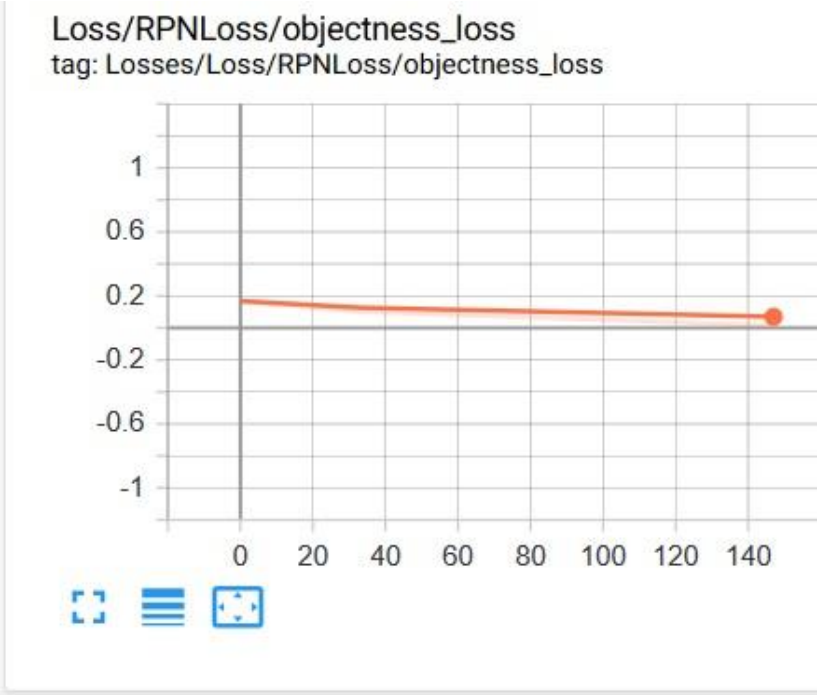


- In X-axis it is the iteration value
- In Y-axis loss rate value
- Loss for the classification of detected objects into various classes

TRAINNING THE MODEL

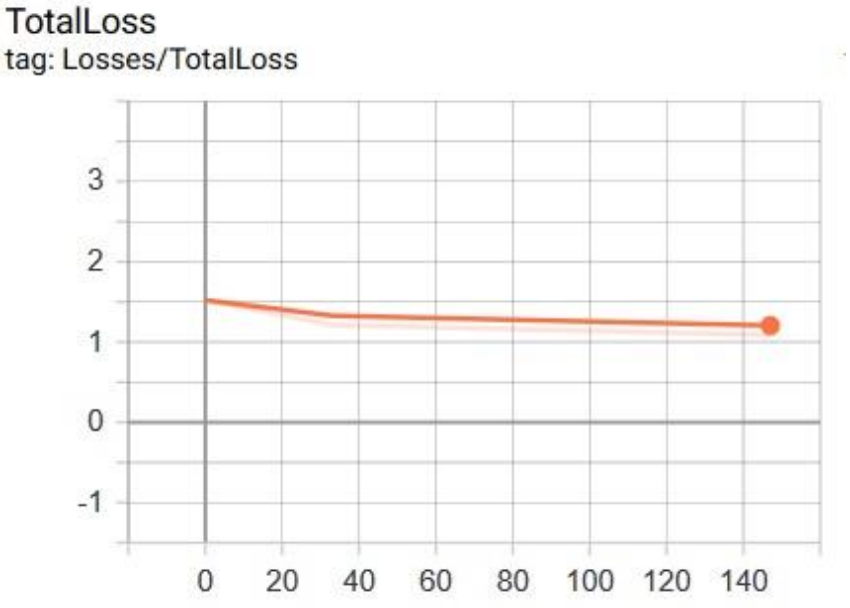
- In X-axis it is the iteration value
- In Y-axis loss rate value
- Localization Loss or the Loss of the Bounding Box regressor

TRAINNING THE MODEL



- In X-axis it is the iteration value
- In Y-axis loss rate value
- Loss of the Classifier that classifies if a bounding box is an object of interest or background

TRAINNING THE MODEL



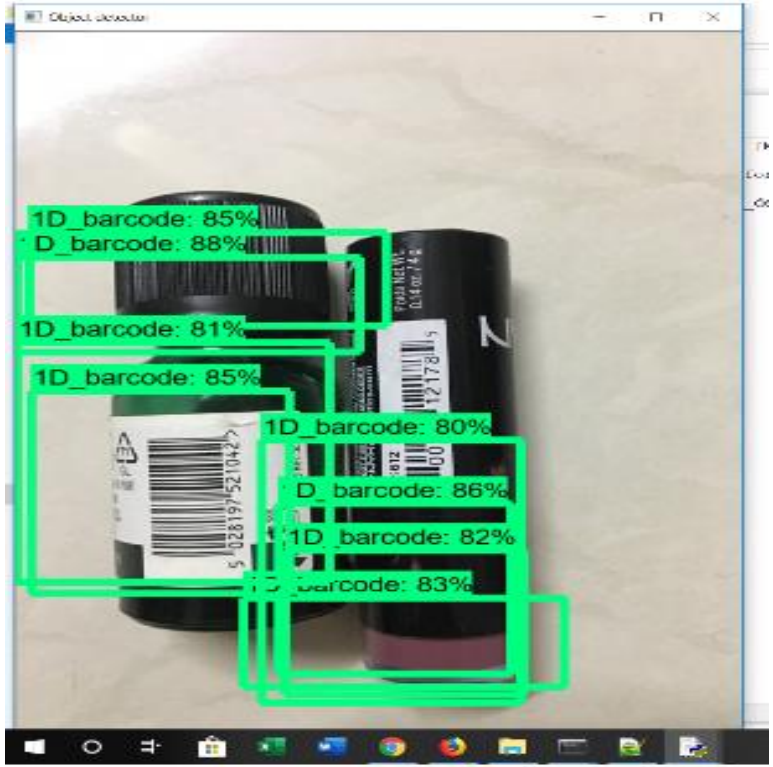
- In X-axis it is the iteration value
- In Y-axis loss rate value
- Total loss indicates all values added

TRAINNING THE MODEL

- In X-axis it is the iteration value
- In Y-axis loss rate value
- After training for long 3.5 hours total loss comes down close to zero

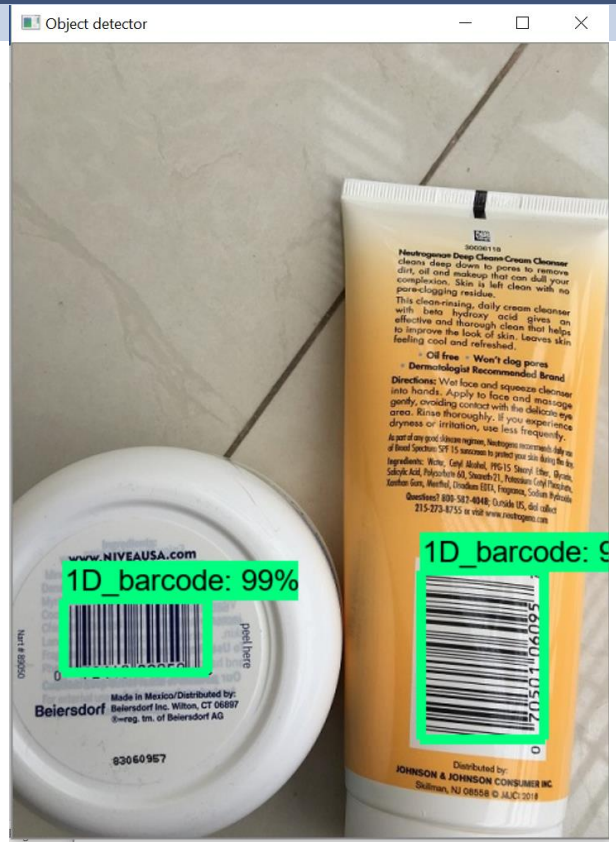
RESULT ANALYSIS

DETECTOR'S OUTPUT



- Detector's output when trained on small dataset
- Unable to find the regions properly
- False positive regions inside the bounding box

DETECTOR'S OUTPUT



- Detector's output when trained on large dataset
- image was part of initial training set
- Multiple barcodes were detected and
- detection region was in the probability of 99%

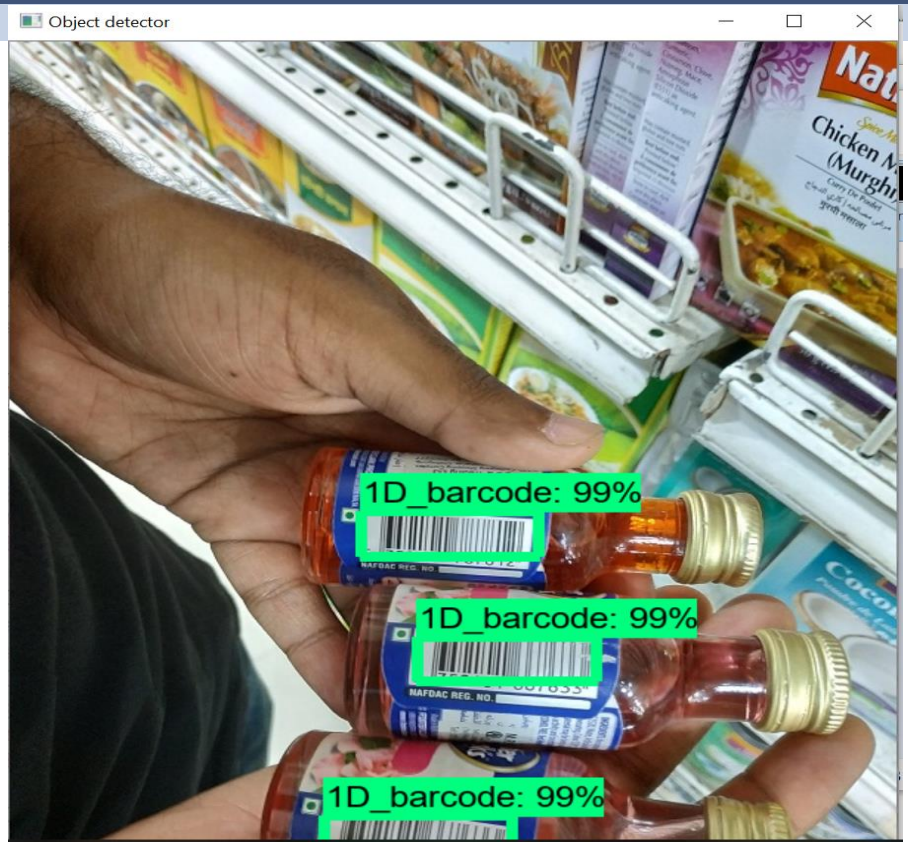
DETECTOR'S OUTPUT

- Detector's output when trained on large dataset
- Image was not part of initial training set
- Multiple barcodes were detected
- False positive regions were detected

DETECTOR'S OUTPUT

- Detector's output when trained on large dataset
- Image was not part of initial training set
- Objects were overlapping
- Detection regions was in the probability of 99%

DETECTOR'S OUTPUT



- Detector's output when trained on large dataset
- Tiny object's barcode was a concern
- Multiple barcodes were detected with the probability of 99%

DECODING

DECODING

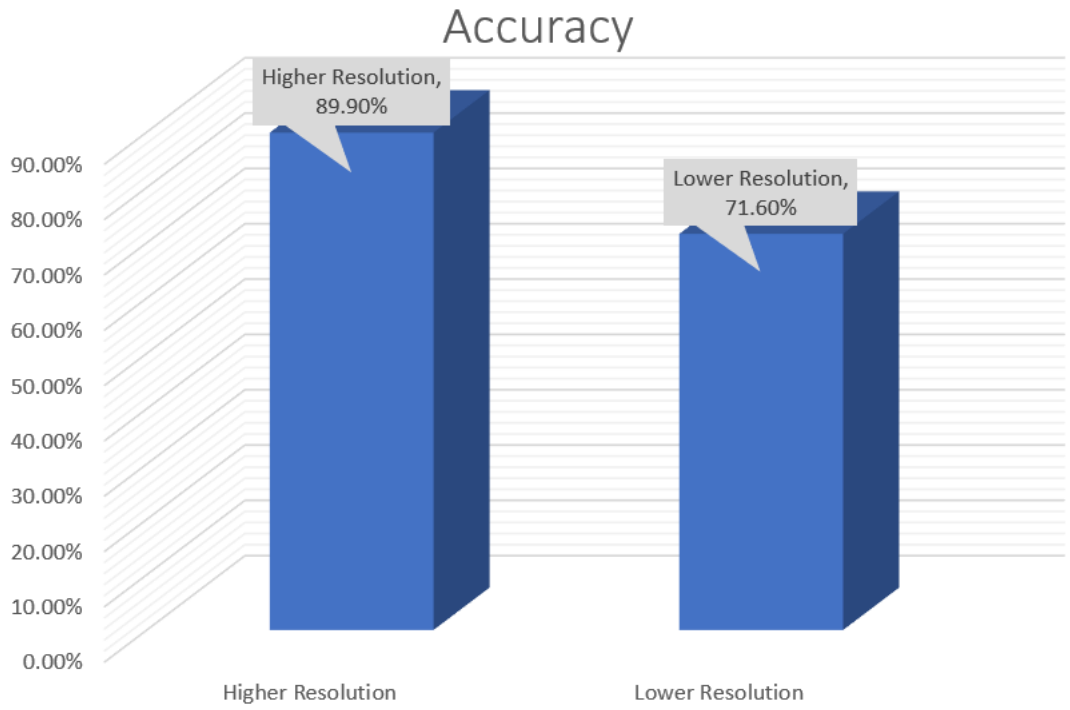
- The detector is unable to decode
- Zbar library is used for decoding as it was previously used for single barcode decoding
- All detected barcode regions were separated
- Then decoded with Zbar individually

DEMO OF DECODING

```
In [1]: runfile('C:/Users/tuktuk/Documents/Thesis Code/objectdetection/bar_test.py',
wdir='C:/Users/tuktuk/Documents/Thesis Code/objectdetection')
1560619044.6314487 1.0239979611062819e-05
Type :  EAN13
Data :  b'0012000809941'
```

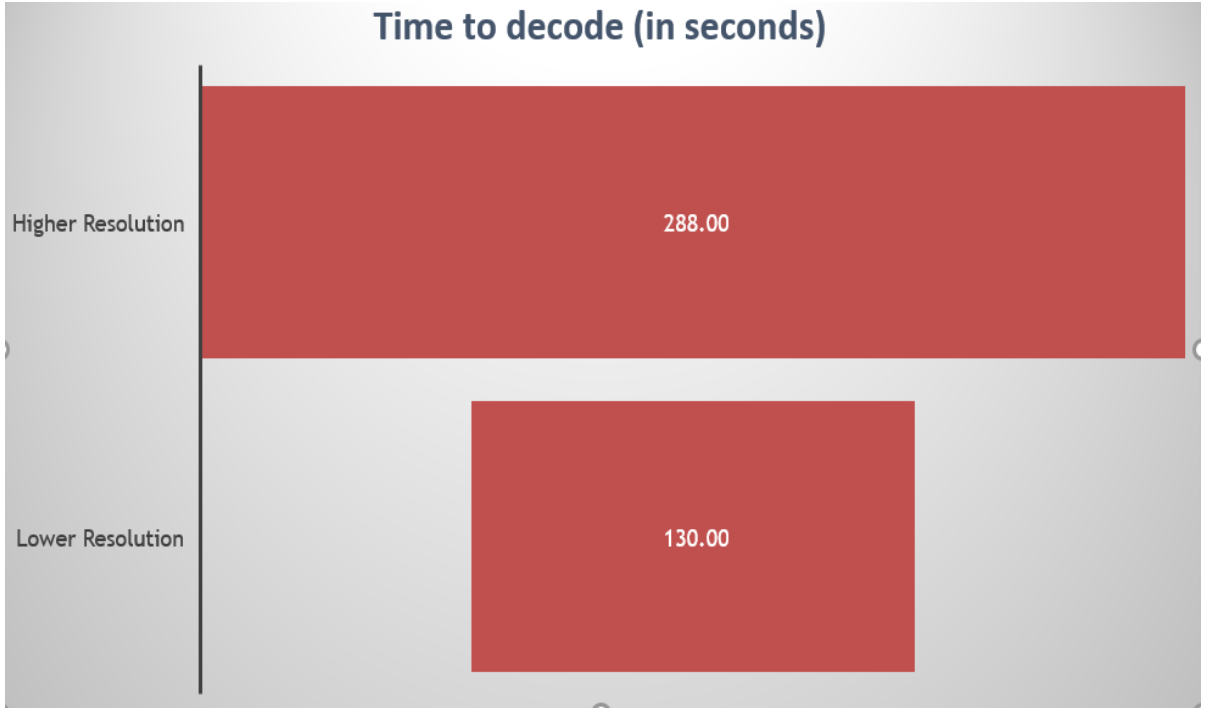
- Decoding is done on image consisting single barcode
- By decoding get TYPE and VALUE

SINGLE 1D BARCODE DECODING ACCURACY



- Arte-lab dataset was used
- Accuracy was measured by how many barcodes were decoded
- Higher the resolution higher the accuracy

SINGLE 1D BARCODE DECODING ACCURACY



- Arte-lab dataset was used
- How much time spent decoding all the images
- Lower the resolution requires less time

CONCLUSION & FUTURE WORK

LIMITATIONS

Though we were successful building a detector, there are limitations in our current work. Detection and decoding works separately. We will try to overcome them in future

FUTURE WORK

- Building a better detector than the current one
- Building a better classifier
- Joining detection and decoding
- Improving the detector’s time
- Making real time application, working with videos
- Decoding with deep-learning

CONCLUSION

In conclusion we hope build a system with user friendly interference. Our work will be beneficial for consumers as well as it will increase business productivity also.

THANK YOU!

PLEASE SUGGEST US