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Vishwakarma Government Engineering College, Chandkheda-382424
(Affiliated with Gujarat Technological University, Ahmedabad)

A
Report
On

OBJECT DETECTION

Prepared as a part of the requirement for the subject of
DESIGN ENGINEERING – IIA
B.E- Semester- V
TEAM ID: 249976
(Computer Engineering Branch)

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Academic Year

2020-21



DEPARTMENT OF COMPUTER ENGINEERING

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CERTIFICATE

This is to certify that the Project Report entitled

“Object Detection”

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Towards the partial fulfillment in Design Engineering – II-A of Gujarat Technological University is the record of work carried out by our team under the supervision and guidance in the Academic Year 2020-21.

The work submitted has in our opinion reached a level required for being accepted for examination. The results embodied in this Project Work to the best of our knowledge have not been submitted to any other University or diploma.

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With great pleasure, I take this opportunity to express my deep sense of gratitude and indebtedness to my renowned and esteemed guide **Prof. Kaushik rana** Assistant Professor, Department of Computer Engineering, Vishwakarma Government Engineering College, Chandkheda for her consummate knowledge, due criticism, invaluable guidance and encouragement which has enabled us to give present shape to this work.

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Finally, I would like to thank our friends and family for their support and patience throughout the year, and other faculty member of the department for his everlasting willingness to extend his support and help in the completion of this work. especially to our parents who without their encouragement and financial support, this would not have been possible.

Yours Sincerely ,

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ABSTRACT

21'st Century is the era of technology. In this ever changing time's our life are mostly governed by machines and electronic devices. And one of the factor which shaped the scenario of technology is ability to detect object by the machines. Object detection is a key ability required by most computer and surveillance devices.

The research on this area has been making great progress. Object detection and tracking has a variety of uses. Object detection and recognition is a computer vision technique for identifying objects in images or videos. Object recognition is a key technology behind driverless cars, enabling them to recognize a stop sign or to distinguish a human from electric pole.

The principal idea behind this concept is AI (Artificial Intelligence) and ML (Machine Learning). With the recent advancement in this two field it has made possible to come up with maximum possible optimization required for processing images.

Object detection is breaking into a wide range of industries, with use cases ranging from personal security to productivity in the workplace (Machine learning uses).

It is applied in many areas of computer vision, including: -

- Image retrieval.
- Security.
- Surveillance.
- Automated vehicle system
- Optical character recognition (vehicle number plate checking)

Still there are lots of challenges in this field but possibilities are endless when it comes to future uses.

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1. INTRODUCTION OF PROJECT

Object detection is a computer technology related to computer vision and image processing that detects and defines objects such as persons, vehicles and animals from digital images and videos.

It is an important task in image processing and computer vision. It is concerned with determining the identity of an object being observed in an image. Humans can recognize any object in the real world easily without any efforts, on contrary machines by itself cannot recognize objects. Object Detection is a basic visual perception task and one of the key areas of applications of Computer Vision. It essentially deals with finding and locating specific objects within an image.

In this project, research have been done and implemented in order to have knowledge about various frameworks and mathematical concept which have been used to create the prototype which is designed to fulfill the tasks determined in accordance with activities described above.

First, it was determined what functions to inculcate in these application and what features to implement. Object detection is an application that can carry out the desired activities for fulfilling needs required by the people.

Object recognition methods frequently use extracted features and learning algorithms to recognize instances of an object or images belonging to an object category. Object recognition aims at classifying objects into a category whereas object detection aims at locating a specific object of interest in digital images or videos. Every object has its own particular features that characterize themselves and differentiate them from the rest

The emerging fields of AI and ML is extremely dynamic. The possibilities are sometimes hard to grasp. It's precisely because of this that people and stakeholders currently have at their disposal an immense possibilities of choices.

2. CANVASES

2.1 AEIOU SUMMARY

1. ACTIVITY:

- This section will include the applications of the product such as: Tracking, detecting, recognition etc.

2. ENVIRONMENT:

- This will include the where the product would be used such as: laboratories, roads for traffic rule checks etc.

3. INTERACTION:

- This will include people using for personal use to business client for their own goals

4. OBJECTS:

- This section of the equipment used or on which it is going to be used such as camera.

5. USERS:

- As usual it will include the people who are associated with the product like tech industry, government etc.



FIGURE 2.1: AEIOU SUMMARY CANVAS

2.2 MIND MAPPING

This canvas is summarization canvas for all the things used during the designing process. Also we include problems and solutions in this canvas. This canvas is very useful to develop application.

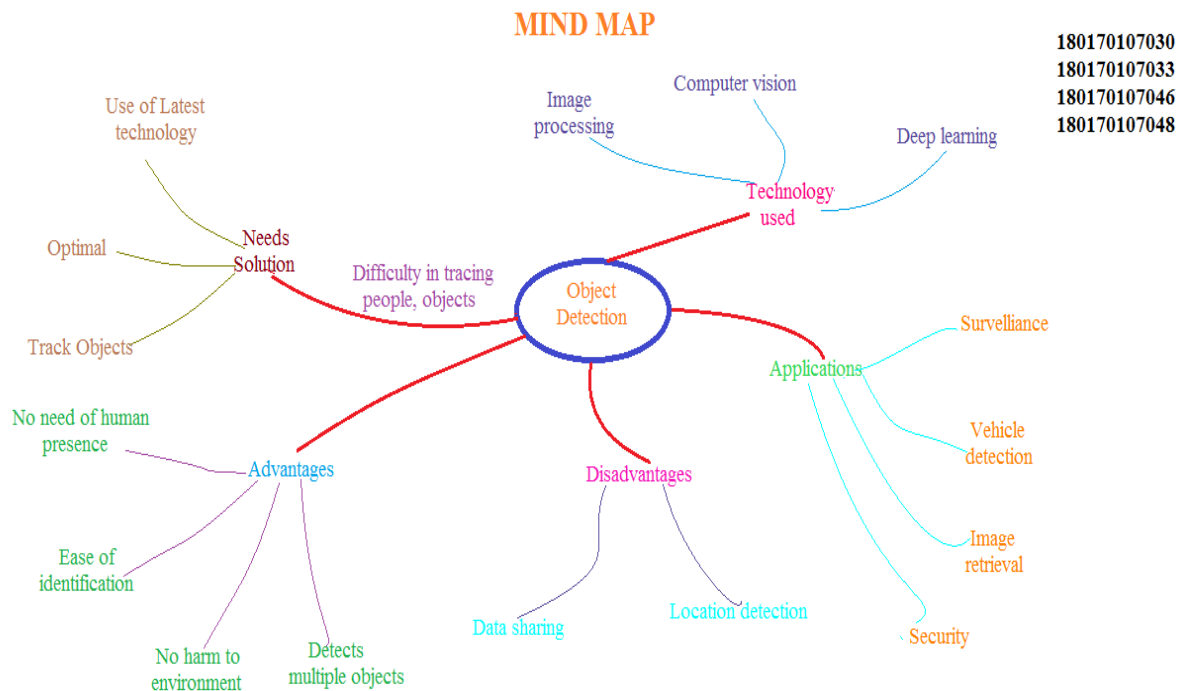


FIGURE 2.2: MIND MAPPING CANVAS

2.3 EMPATHY CANVAS

This is the first step of the project or a problem. In this canvas, we will find out what is user? Who is a User? What is Stakeholder? Who are they? And what are the broad stories of their activities?

1. User:

- In this stage, we find various users who are directly or indirectly related to our product.
- For Example: Government Agencies ,Professionals, Common People, etc.

2. Stakeholders:

- Stakeholders are people or an organization with an interest.
- In this stage, we find those users which are directly or indirectly related to the users.
- For Example: working professionals, suppliers etc.

3. Activities:

- Activities are directly or indirectly related to the stakeholders.
- For Example: Image Retrieval, surveillance, face detection etc.

4. Story boarding:

- Most interesting part was the ‘Story Boards’ which can be called the board of emotion understanding the problem of society is one of the biggest challenges

for engineering student as till now they were making projects on imaginary ideas.

- It helped us understanding that when we build anything for anyone, the purpose and emotion behind that are equally important.

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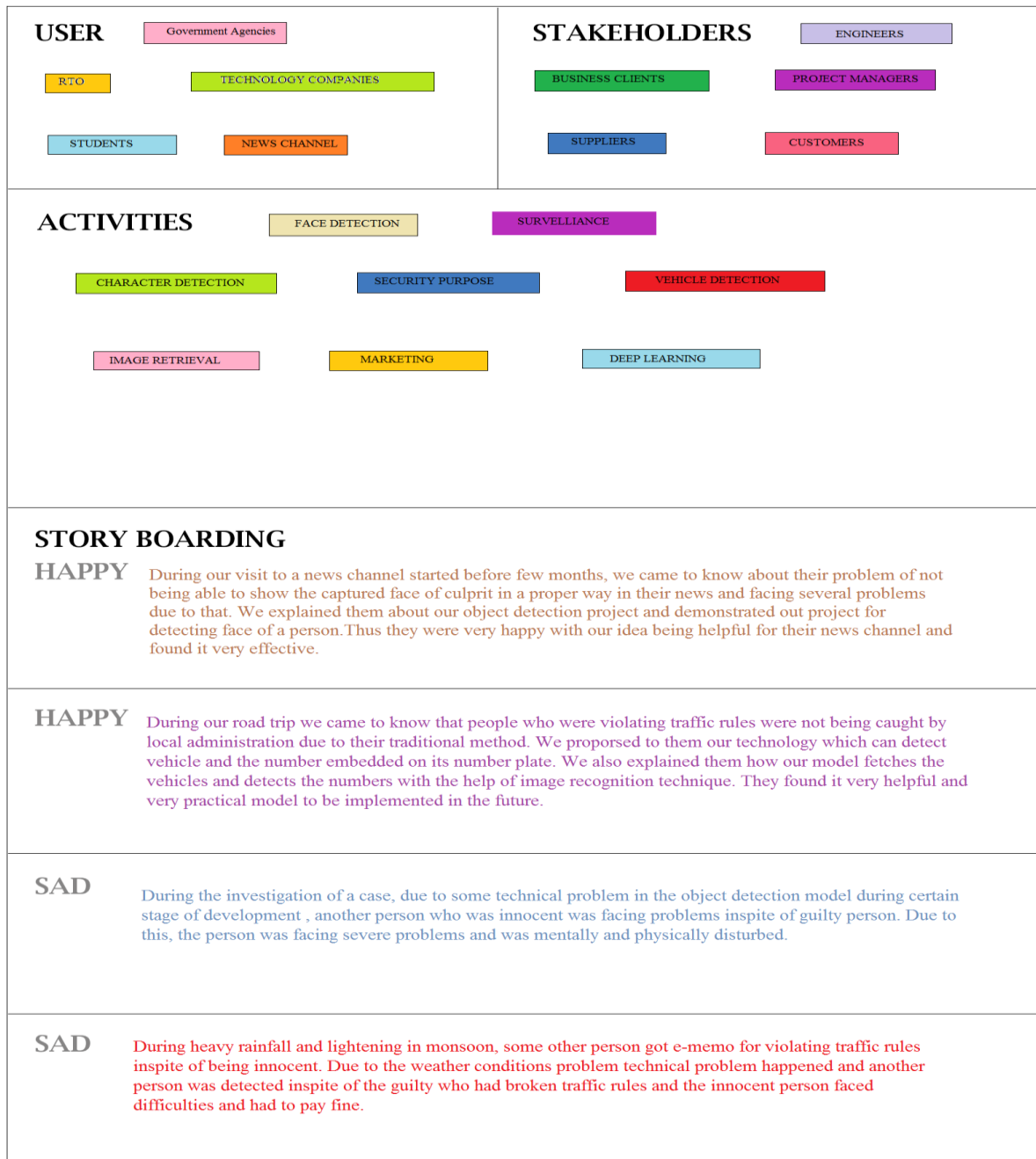


FIGURE 2.3: EMPATHY CANVAS

2.4 IDEATION CANVAS

This canvas consists of the ideology behind the user, so in this canvas some brief ideas are expressed. Then we listed out that what activity every segment of people does. Then we thought about situation/context/location and finally for possible solutions of the mentioned problem.

1. PEOPLE:

- Government agencies
- Tech Industry

2. ACTIVITIES:

- Designing
- Analysing
- Detecting



FIGURE 2.4: IDEATION CANVAS

2.5 PRODUCT DEVELOPMENT CANVAS:

In this canvas we mentioned purpose of our product, functions, features and products experience. For this purpose, we defined some functions that our product must do. These included, for each of the function that our product fulfills, also there is some features of our product. This must be the way to go as using various varieties of technology, and taking reference of the canvas for customer revalidation & customer feedback. We come across this idea. At the last canvas focuses on the revalidation & customer feedback this cycle must be maximized so that the product must be perfectly related to user.

1. PURPOSE:

- The most important and the most needed purpose of our products using Object detection is **IT ACT AS MULTI PLATFORM SERVICE and it also sets an basis for the future techs to come so the fields of security and surveillance can prosper.**

2. PEOPLE:

- The most basic users of such kind of products are engineers. As they use such type of technology and get more from it. Next comes a Government agencies they will use to get more out of their traffic security system or maybe for surveillance purposes. After that there are various users such as Tech industry who uses it for their own personal goals.

3. PRODUCT FEATURES:

- The most important feature of this is that it makes locating objects and identifying them easy.
- Secondly it is **User Friendly and Easy to use.**
- It can be easily accessed using appropriate equipment's and devices and make it good for use.
- Lastly another important feature of such kind of products is it is reliable and convenient to use.

4. PRODUCT FUNCTIONS:

- The three most important and basic functions of these products are:
 1. Image Recognition
 2. Tracking objects and surveillance.
 3. Multi detection.

5. CUSTOMER REVALIDATION:

- Here comes the very important part of developing any product, Customer Revalidation. As to decide that the product is successful or not Customer Satisfaction is must.
- Now image below shows the customer reviews and ratings on various aspects of the product.

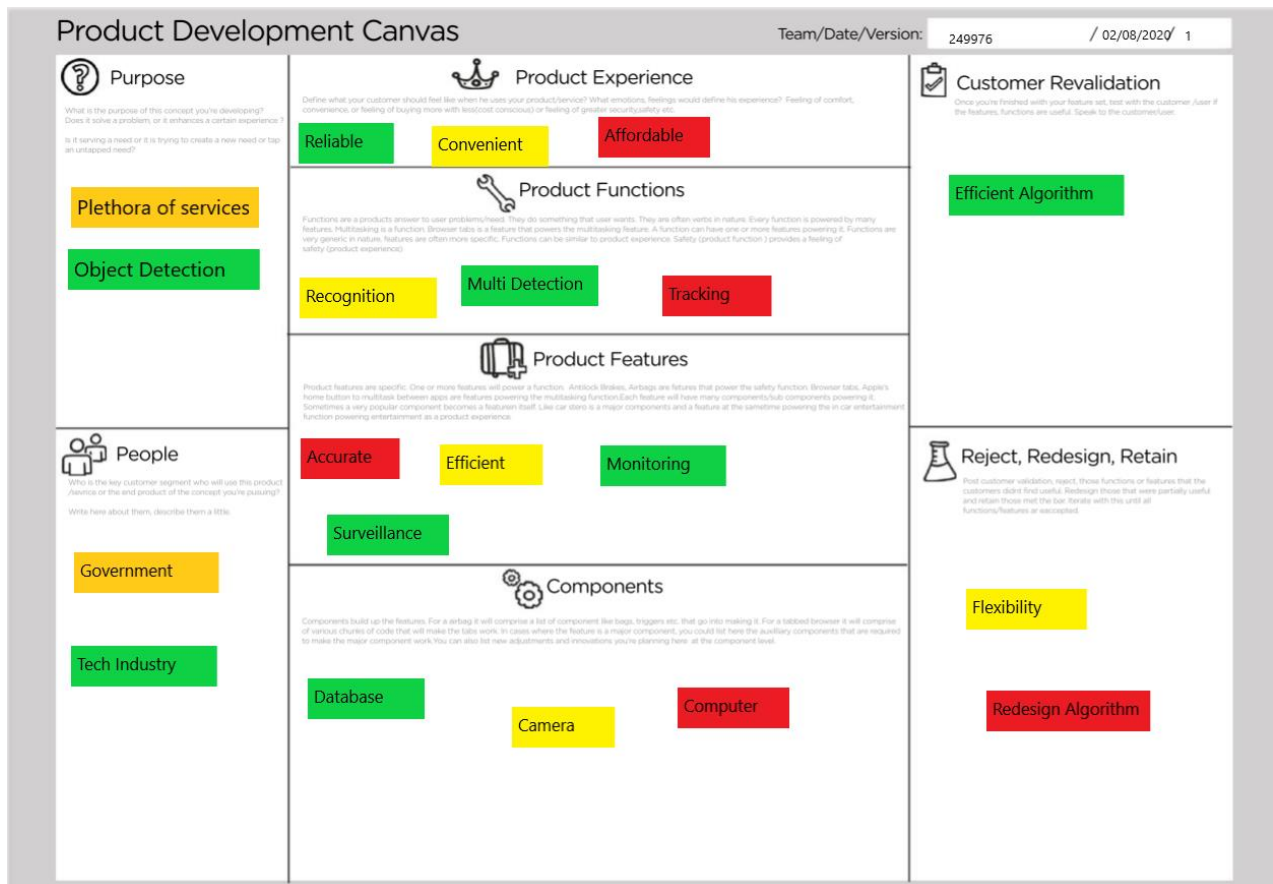


FIGURE 2.5: PRODUCT DEVELOPMENT CANVAS

3. LITERATURE REVIEW/SECONDARY RESEARCH

The purpose of LNM is to identify the requirements of learning among the team members. While a new product/process is under development based on a unique idea (to reduce the level of difficulty faced by a user), the team members need to learn and explore a lot of new skills and documents, methods and guidelines.

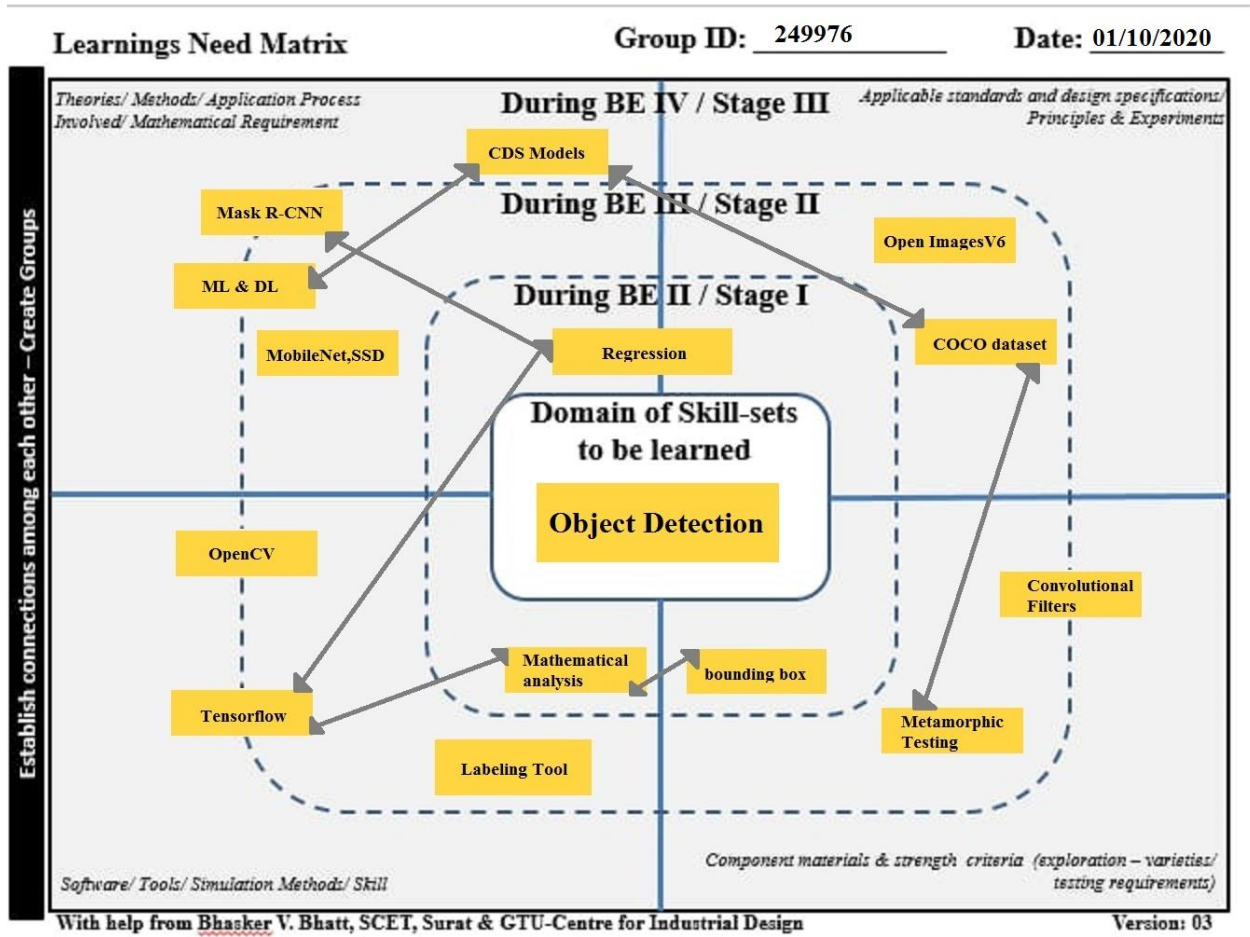


FIGURE 3.1: LEARNING NEED MATRIX

It includes prerequisite needed for making product which should be considered before going into the development phase so that we don't encounter any problem later on.

It is divided into stages with each having different criteria and topic to be covered while designing the final product.

4. DESIGN CONSIDERATION FOR DETAIL DESIGN

4.1 DESIGN FOR PERFORMANCE, SAFETY AND RELIABILITY

Performance optimization generally focuses on improving just one or two aspect of the system's performance, e.g. execution time, memory usage, disk space, bandwidth etc. This will usually require a trade-off where one aspect is implemented at the expense of others. For example increasing the size of `_cache` improves run-time performance, but also increases the memory consumption.

- **Algorithm**
YOLO algorithm is an algorithm based on regression, instead of selecting the interesting part of an Image, it predicts classes and bounding boxes for the whole image in one run of the Algorithm.
- **Build Level**
Tensor Flow is an open source library for numerical computation and large-scale machine learning. Tensor Flow bundles together a slew of machine learning and deep learning (aka neural networking) models and algorithms and makes them useful
- **Optimizing Image usage**
Most Images can be optimized and made smaller.

SAFETY AND RELIABILITY

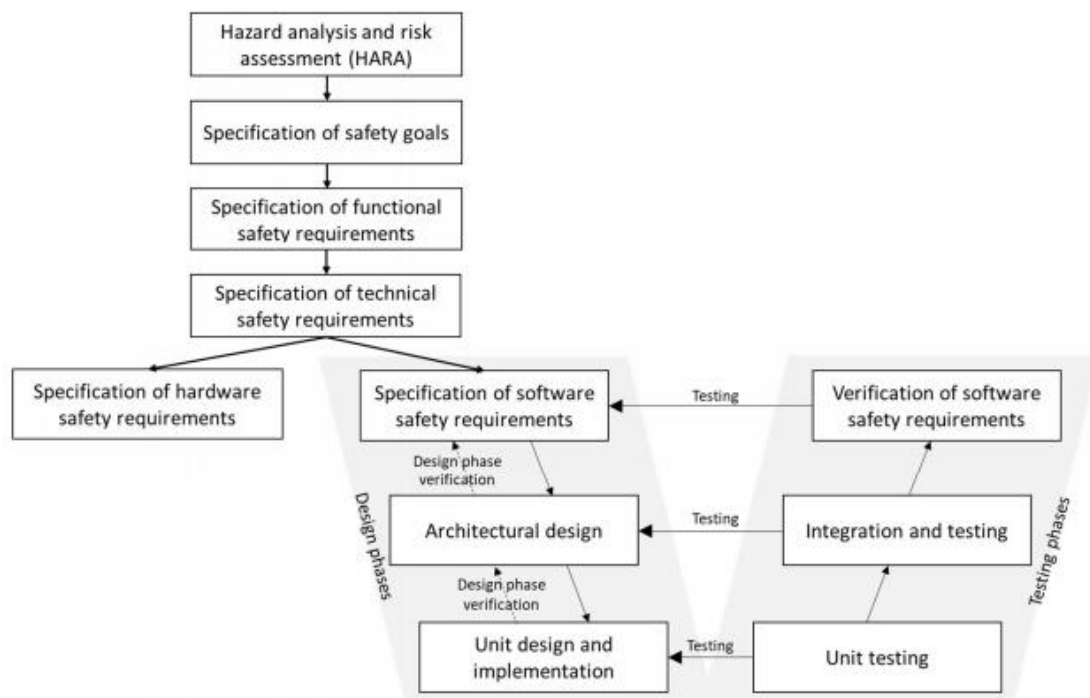


FIGURE 4.1: SOFTWARE SAFETY AND RELIABILITY

The criteria in the proposed software safety model pertains to system hazard analysis, completeness of requirements, identification of software-related safety-critical requirements, safety- constraints based design, run-time issues management and software safety-critical testing.

4.2 DESIGN FOR ERGONOMICS AND AESTHETICS.

AESTHETICS

Aesthetics is a core design principle that defines a design's pleasing qualities. In visual terms, aesthetics includes factors such as balance, color, movement, pattern, scale, shape and visual weight. Designers use aesthetics to complement their designs' usability, and so enhance functionality with attractive layouts

Aesthetics in software development has two main applications

- It gives information about interface from interaction with user and product.
- It makes software appealing to user so they enjoy interacting with it.

Ergonomics (or human factors) is the discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

Software ergonomics is a subcategory of ergonomics that concerns the software design, rather than the hardware design, of systems.

Software ergonomics includes the determination of

- user needs, (Self Explanatory)
- interface design:-

Includes the design of the inputs that can be made by the user and responses (outputs) provided by the system

- user support :-

Includes material that will support the user in learning and using the system. Such materials include overviews, online help, performance aids, documentation, tutorials and training.

- Usability testing.

Includes the develop of a test plan the development of test senarios, conducting the testing according to the plan, and reporting test results.

4.3 DESIGN FOR MANUFACTURABILITY AND ASSEMBLY(DFMA)

Design for Manufacturing and Assembly (DFMA) is an engineering methodology that focuses on reducing time-to-market and total production costs by prioritizing both the ease of manufacture for the product's parts and the simplified assembly of those parts into the final product.

DFM is concerned with selecting cost-effective raw materials and attempting to minimize the complexity of manufacturing operations during the product design phase

DFA is concerned with reducing the product's assembly time, costs, and complexities by minimizing the number of individual parts, assembly steps, and potential for variability in build-quality.

Factors to be considered –

- Planning
Lowering the cost estimation is one of the major factor.
- Materials/Softwares used
Use industry standard frameworks and libraries which determines processes and means and controls quality.
- Processes
Know the designing and implementation process to reduce costs.
- Standards
Use standard protocols and softwares while creating the product.

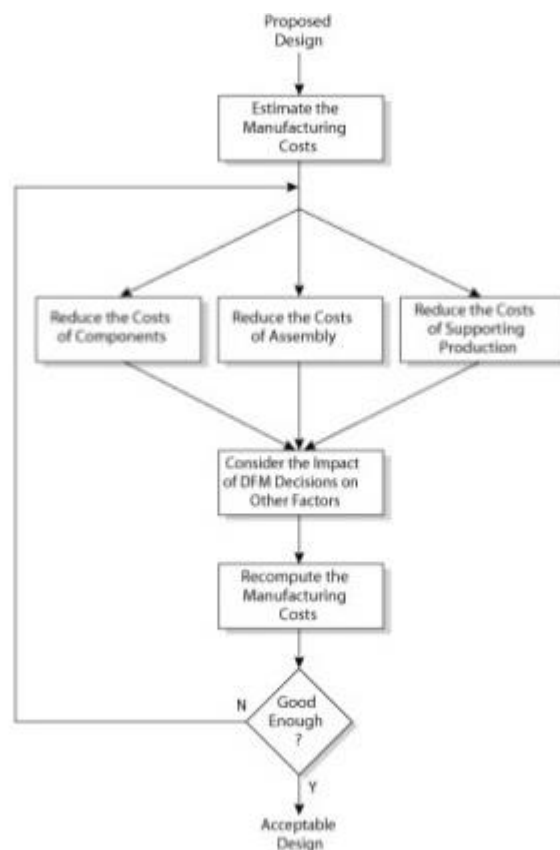


FIGURE 4.3: DFMA CYCLE

4.4 DESIGN FOR COST AND ENVIRONMENT

DfE&C is a collective term for technologies that allow the design of eco-friendly products.

The aim: Sustainable products that remain cost-effective and have fewer negative environmental impacts during the entire product life cycle.

In order to make such decisions, sustainability and compliance data and criteria from all phases of the product life cycle have to be taken into account at the early stage of designing from various aspects to the recycling concepts.

This means that the impact of products on the environment can be significantly reduced by these decisions.

- Production

In our case we could use modules and libraries which are open source and their support is going to last for years to cut production cost without hampering the quality of the product.

- Consumption

During the usage of the product, it has the possibility of saving the energy. The product may be designed to only use as much energy as is necessary in its current state, effectively creating sleep and on modes, or any other variation necessary to be in the most efficient state at that moment.

- Destruction

In our case this won't be applicable. But let's say for electronics it is often not possible to reuse them, as they are not repairable the components of the product must be thrown away, reused, or recycled. So care must be taken while designing and manufacturing from which substance they are made of.

5. DESIGN CALCULATION

For our Prototype we used single object recognition and it uses concept like logistic regression or we can also use CNN(convolutional neural network) the underlying concept remains same but the CNN are known to be fast and efficient.

CNN is designed for single object detection. It encompasses the parameters that were included in each step, layer progression and output image size of every layer. Each layer divides the image matrix into its components and performs an operation on image. The output image size of various layers is different due to manipulations by each layer such as initially the output image size is 28×28 which then reduces to 14×14 due to the max pooling layer which chooses the max valued pixel from the surrounding pixels. It then reduces to 7×7 due to the second max pooling layer. This pixel is then flattened into $7 \times 7 \times 64$ which are 3136($7 \times 7 \times 64$) sized vector.

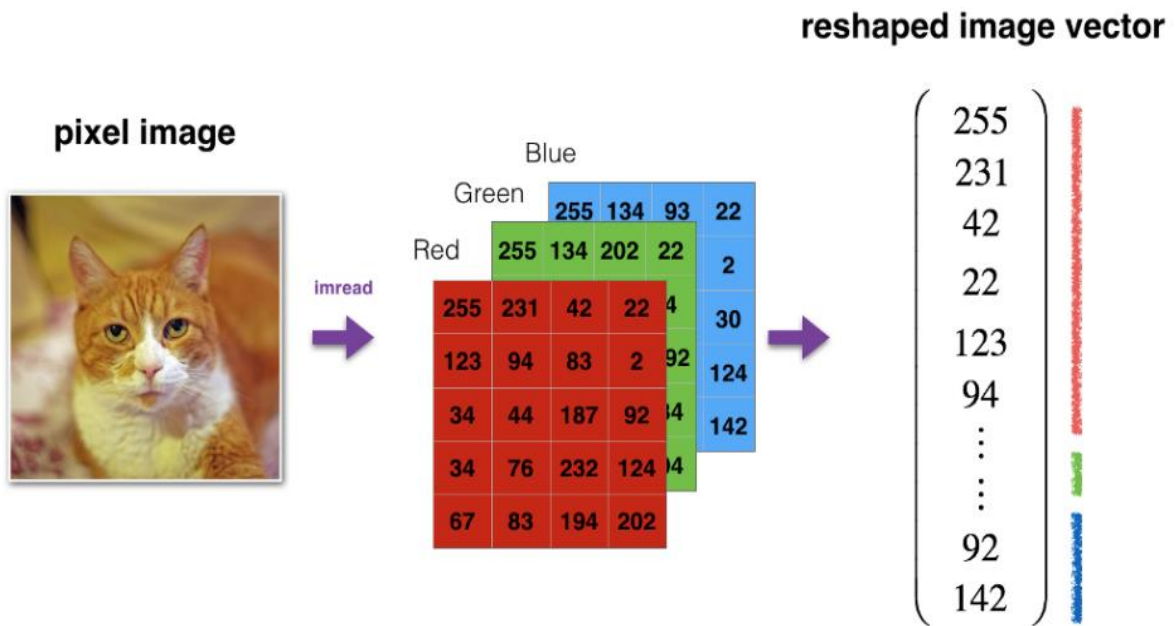


FIGURE 5.1: VECTORIZED IMAGE REPRESENTATION

FLOWCHART OF NEURAL NETWORK

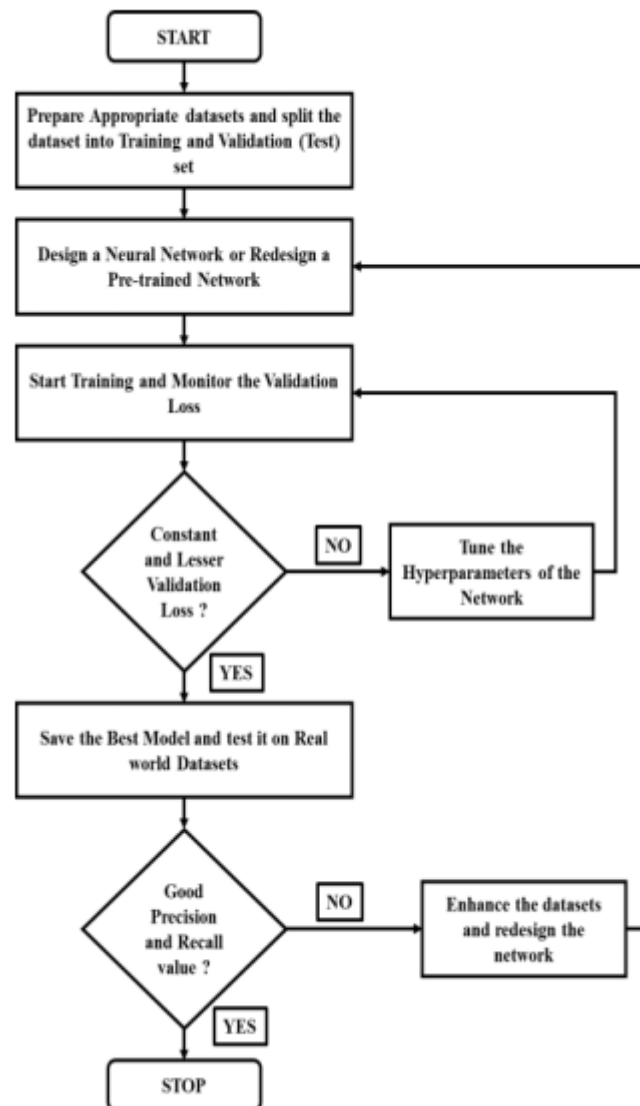


FIGURE 5.2: FLOWCHART NEURAL NETWORK

FOR MULTIPLE OBJECTS WE USE YOLO MODEL

YOLO divides up the image into a grid of 13 by 13 cells: Each of these cells is responsible for predicting 5 bounding boxes. A bounding box describes the rectangle that encloses an object. YOLO also outputs a confidence score that tells us how certain it is that the predicted bounding box actually encloses some object.

Prior detection systems repurpose classifiers or localizers to perform detection. They apply the model to an image at multiple locations and scales. High scoring regions of the image are considered detections.

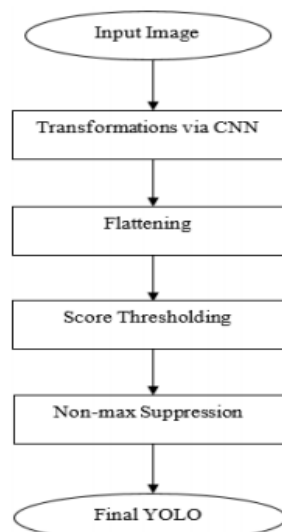


FIGURE 5.3.1: YOLO FLOWCHART

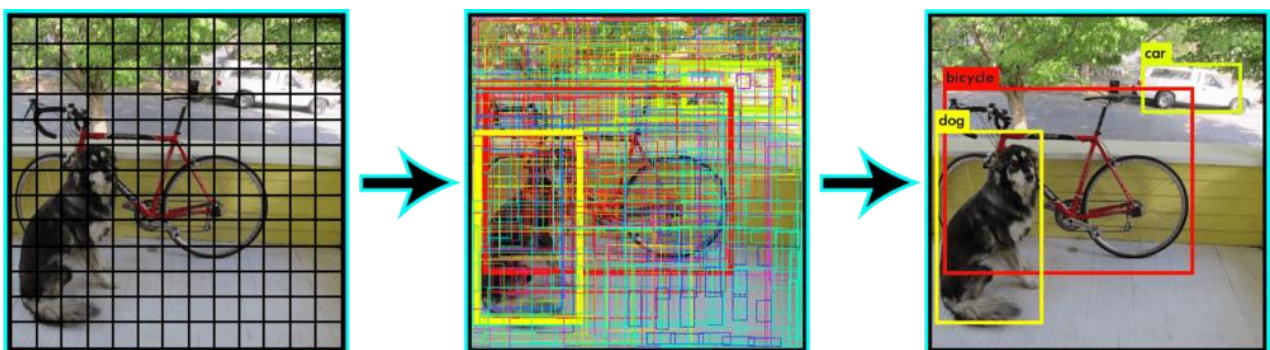


FIGURE 5.3.2: SAMPLE IMAGE

Here you can see 13 X 13 grid which in turn gives bounding boxes which are used to separate an object to different class and they are used to classify them.

6. MEASURING INSTRUMENTS/TESTING AND USES

TESTING

White Box Testing is based on the application's internal code structure. In white-box testing, an internal perspective of the system, as well as programming skills, are used to design test cases in order to improve code efficiency or structure. It is also known as 'Structural' testing.

Testing Levels :-

- **Unit Testing**
Unit Testing is done to check whether the individual modules of the source code are working properly.
- **Integration Testing**
Integration Testing is the process of testing the connectivity or data transfer between a couple of unit tested modules.
- **System Testing**
The software is compiled as product and then it is tested as a whole. This can be accomplished using one or more of the following tests.
- **Acceptance Testing**
It is the last phase of testing where it is tested for user-interaction and response. This is important because even if the software matches all user requirements and if user does not like the way it appears or works, it may be rejected.

USES

Here we have listed some current as well as future uses.

- Object identification
- Face Detection
- Automated driving car
- Ball tracking system.
- Character Recognition(Number plate checking)

7. COMPARISON OF EXISTING MATERIALS, METHODS, TOOLS AND EQUIPMENT FOR OUR PROJECT

TOOLS required are

- Computer/laptop
- Anaconda Navigator
- Keras(for API)
- TensorFlow and OpenCV(libraries)
- Matplotlib, numpy,(Packages)
- Pandas, scikit learn (Packages)
- IDE (Spyder ,Jupyter Notebook)

METHODS used are

- Logistic Regression
- YOLO model
- OOP
- Basic waterfall model

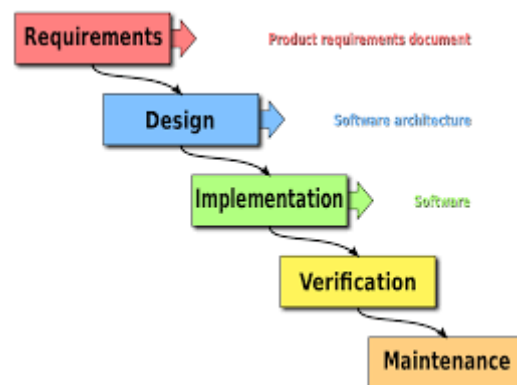


FIGURE 7.1: WATERFALL MODEL

8. CONCLUSION AND FUTURE SCOPE

By considering various aspects at different level in this project our team found many problems faced by people and need to be resolved .we came to following conclusion that inclusion of Artificial Intelligence to solve Computer vision tasks has outperformed the image processing approaches of handling the tasks and allowed advancement in the field of object detection and recognition. The future of object detection has massive potential across a wide range of industries.

- This problem can be solved by application that can make detecting and recognising object through the use of ML(Machine Learning) so that user can get the desired experience.
- This process can be made more efficient through providing an application or website.
- It can help us achieve many things as it brings various functionalities to one platform.

FUTURE WORKS

- We aspire to improve the performance as well as to extend our support to variety of new classes of object.
- We want to introduce this application to various platforms like ios, android etc and also create an online website for availing benefits.

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9. PROOF OF CONCEPTS/PROTOYPE

The Following prototype is an early sample or release of a product built to test a concept or process. Prototyping serves to provide specifications for real, working system rather than a theoretical one. A proof of principle prototype serves to verify some key functional aspect of the intended design, but the usually does not have all the functionality of final product. Below are some screens of prototype:

FIGURE 9.1: SCREEN ONE

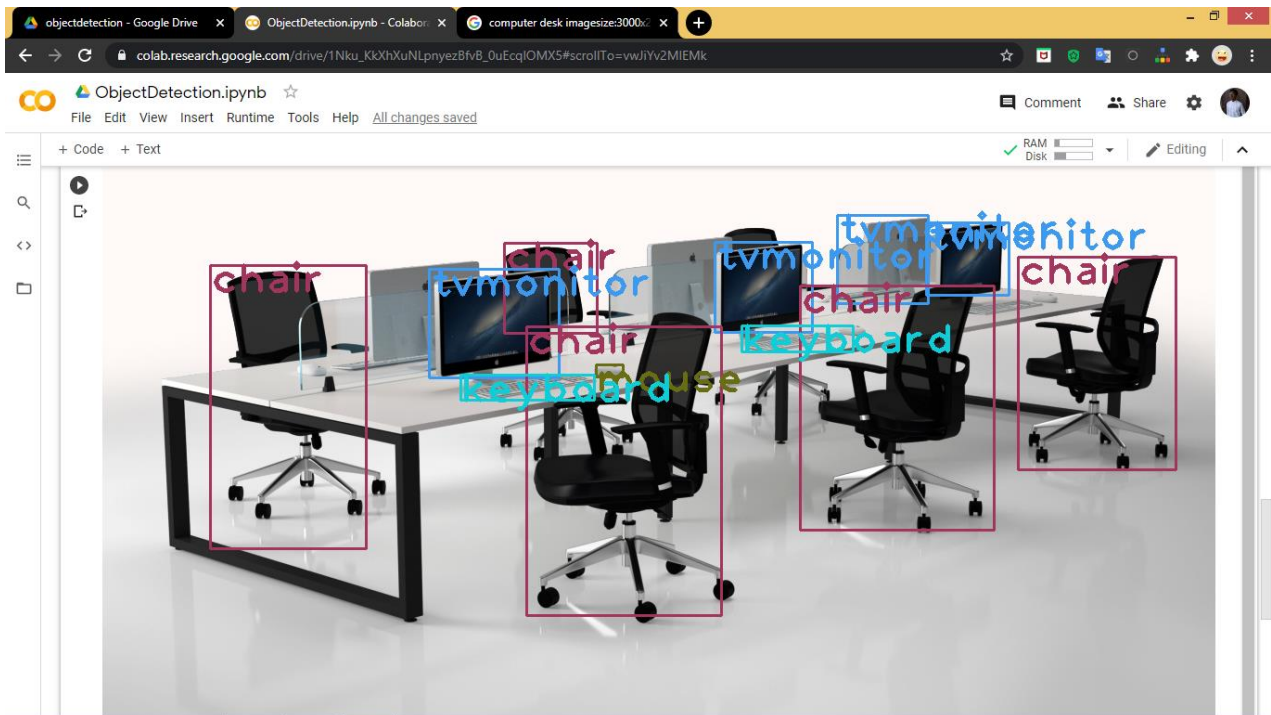


FIGURE 9.2: SCREEN TWO

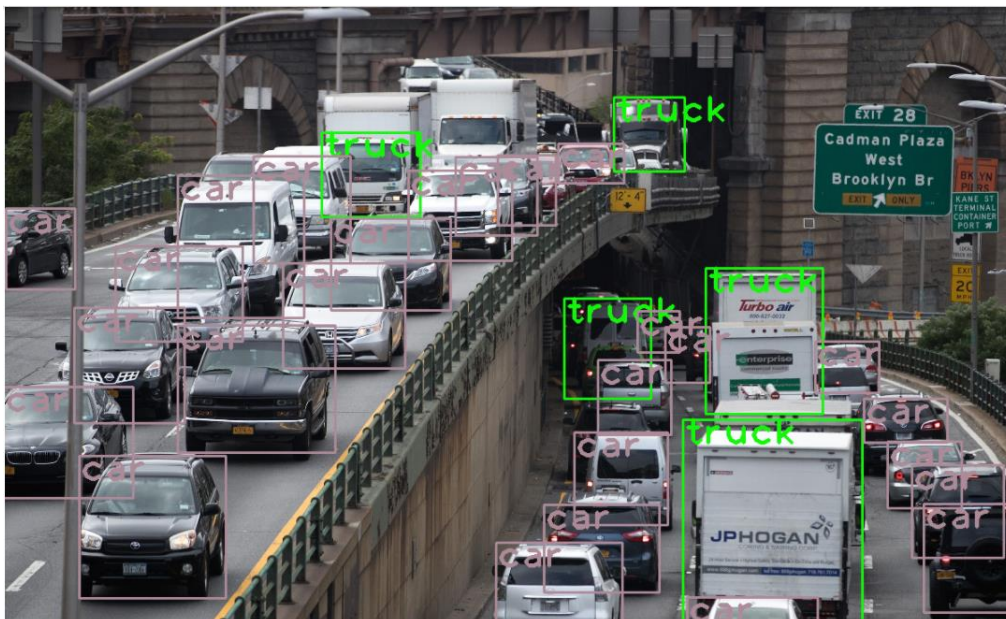


FIGURE 9.3: SCREEN THREE



FIGURE 9.4-SCREEN FOUR



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