FACE MASK DETECTION USING IOT

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ABSTRACT
The purpose of the project "Face Mask Recognition Using Machine Learning" is to create a tool that identifies the image of a human that can calculate the probability that he/she wearing a mask or not. Due to COVID, wearing a face mask is must in order to stay safe. As the country starts going through various stages of reopening, face masks have become an important element of our daily lives to stay safe. Wearing face masks will be required in order to socialize or conduct business. So, this application utilizes a camera to detect if a person is wearing a mask or not.
Keywords: Covid-19, object detection, Transfer learning, two-stage detector, identify prediction

1.1 INTRODUCTION

The aim of the "Face Mask Detection Using Machine Learning" project is to develop a tool that can detect whether a person is wearing a mask or not by analyzing their image and calculating the probability of mask-wearing. This tool is particularly important in the context of COVID-19[1], where wearing a face mask is crucial to staying safe and preventing the spread of the virus. As businesses and public spaces begin to reopen, face masks have become an essential part of our daily lives for socializing and conducting business safely. This application utilizes a camera to identify individuals who are not wearing masks and alert them to do so

2.1 SYSTEM ANALYSIS

The trend of wearing face masks in public is rising due to the COVID- 19 corona virus epidemic all over the world. Before Covid-19, People used to wear masks to protect their health from air pollution. While other people are self-conscious about their looks, they hide their emotions in the public to hide their faces. More than five million cases were infected by COVID- 19 in less than 6 months across 188 countries. The virus spreads through close contact and in crowded and overcrowded areas. We can tackle and predict new diseases by the help of new Technologies such as artificial intelligence, Iot, Big data, and Machine learning[2]. People are forced by laws to wear face masks in public in many countries. These rules and laws were developed as an action to the exponential growth in cases and deaths in many areas. However, the process of monitoring large groups of people is becoming more difficult in public areas. So we will create a automation process for detecting the faces. Here we introduce a facemask detection model that is based on computer vision and deep learning. The proposed model can be integrated with Surveillance Cameras[3] to impede the COVID-19 transmission by allowing the detection of people who are wearing masks not wearing face masks. The model is integration between deep learning and classical machine learning techniques with Open cv, Tensor flow and Keras.

2.2 EXISTING SYSTEM

The year 2020 has shown mankind some mind-boggling series of events amongst which the COVID-19 pandemic is the most life-changing event which has startled the world since the year began. Affecting the health and lives of masses, COVID-19 has called for strict measures to be followed in order to prevent the spread of disease. From the very basic hygiene[4] standards to the treatments in the hospitals, people are doing all they can for their own and the society's safety; face masks are one of the personal protective equipment. People wear face masks once they step out of their homes and authorities strictly ensure that people are wearing face masks while they are in groups and public places.

2.3 PROPOSED SYSTEM

To overcome the drawbacks of the existing system, the proposed system has been evolved. This projects aim is to monitor that people are following the basic safety principles. This is done by developing a face mask detector system. Face mask detection means to identify whether a person is wearing a mask or not. The first step to recognize the presence of a mask on the face is to detect the face, which makes the divided into two parts: to detect faces and to detect masks on those faces Face detection is one of the applications of object detection and can be used areas like security, biometrics, law enforcement and more The implementation of the algorithm is on images, videos and live video streams. There are many detector systems developed around the world and being implemented. However, all this science needs optimization; a better, more precise detector, because the world cannot afford any more increase in corona cases.

Figure2.3: face detection

2.4FEASIBLITY STUDY

Feasibility analysis[5] begins once the goals are defined. It starts by generating broad possible solutions, which are possible to give an indication of what the new system should look lime. This is where creativity and imagination are used. Analysts must think up new ways of doing things- generate new ideas. There is no need to go into the detailed system operation yet. The solution should provide enough information to make reasonable estimates about project cost and give users an indication of how the new system will fit into the organization. It is important not to exert considerable effort at this stage only to find out that the project is not worthwhile or that there is a need significantly change the original goal. Feasibility of a new system means ensuring that the new system, which we are going to implement, is efficient and affordable. There are various types of feasibility to be determined. They are,

2.4.1Economically Feasibility

Development of this application is economically feasible. The only thing to be done is making an environment with an effective supervision. It is cost effective in the sense that has eliminated the paper work completely and saves the time.

2.4.2Technical feasibility

Evaluating the technical feasibility is the trickiest part of a feasibility study. This is because, at this point in time, not too many-detailed design of the system, making it difficult to access issues like performance, costs on (on account of the kind of technology to be deployed) etc. A number of issues have to be considered while doing a technical analysis.

1.Understand the different technologies involved in the proposed system: Before commencing the project, we have to be very clear about what are the technologies that are to be required for the development of the new system.

2.Find out whether the organization currently possesses the required technologies: Is the required technology available with the organization? If so is the capacity sufficient? For instance -

"Will the current printer be able to handle the new reports and forms required for the new system?

2.4.3Operational Feasibility

Proposed projects are beneficial only if they can be turned into information systems that will meet the organizations operating requirements. Simply stated, this test of feasibility asks if the system will work when it is developed and installed. Are there major barriers to Implementation[6]? Here are questions that will help test the operational easibility of a project Is there sufficient support for the project from management from users? If the current system is well liked and used to the extent that persons will not be able to see reasons for change, there may be resistance. Are the current business methods acceptable the user? If they are not, Users may welcome a change that will bring about a more operational and useful systems. Have the user been involved in the planning and development of the project? Early involvement reduces the chances of resistance to the system and in genera and increases the likelihood of successful project. Since the proposed system was to help reduce the hardships encountered. In the existing manual system, the new system was considered to be operational feasible.

3SPECIFICATION

3.1HARDWARE REQUIREMENTS (Minimum Requirement)

1.RAM:4GB+RAM
2.PROCESSOR: i3 5th Gen 2.2 Ghz

3.2SOFTWARE REQUIREMENTS

1.Domain: Python
2.Version: Python IDLE (3.8.0)
3.Code Editors: PyCharm, Notepad++, Jupyter
4.Frameworks and Dependencies: Tensor flow, Keras, Open CV
5.Operating System: Windows 10

4.1CODE EDITORS

4.1.1PyCharm

PyCharm is an integrated development environment[7] (IDE) used In computer programming, specifically for the Python language. It is developed by the Czech company Jet Brains (formerly known as IntelliJ). It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems (VCSes), and supports web deve
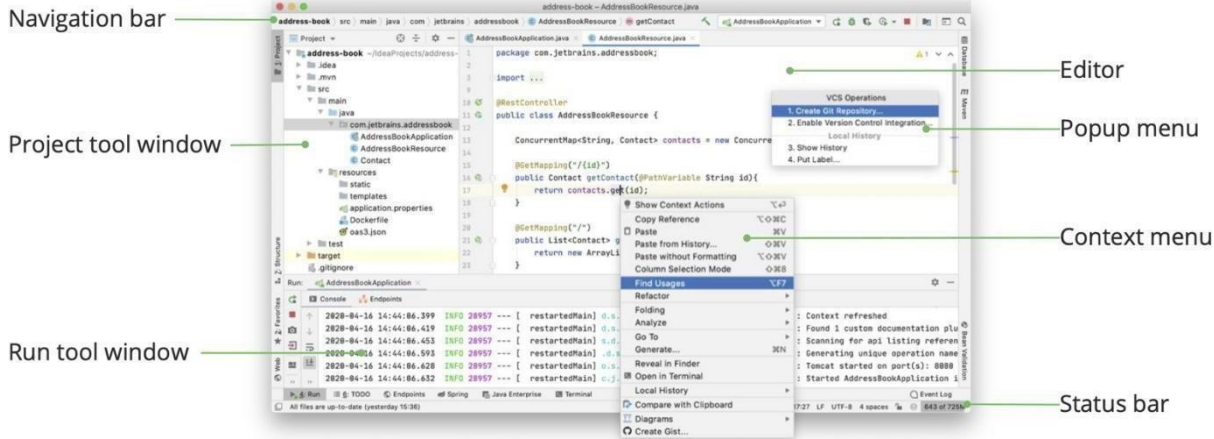

Figure4.1.1: pychram screen

lopment with Django as well as data science with Anaconda
•Coding assistance and analysis, with code completion, syntax and error highlighting, linter integration, and quick fixes
•Project and code navigation: specialized project views, file structure views and quick jumping between files, classes, methods and usages
•Python refactoring: includes rename, extract method, introduce variable, introduce constant, pull up, push down and others
•Integrated Python debugger
•Integrated unit testing, with line-by-line code coverage
•Google App Engine Python development
•Version control integration: unified user interface for Mercurial, Git, Subversion, Perforce and CVS with change lists and merge
•Support for scientific tools like matplotlib, numpy and scipy [professional edition only]
PyCharm provide an API so that developers can write their own plugins to extend PyCharm features. Several plugins from other JetBrains IDE also work with PyCharm. There are more than 1000 plugins which are compatible with PyCharm

4.1.2Notepad++

Notepad++ is a free (as in "free speech" and also as in "free beer") source code editor and Notepad replacement that supports several languages. Running in the MS Windows environment, its use is governed by GNU General Public License. Based on the powerful editing component Scintilla, Notepad++ is written in C++ and uses pure Win32 API and STL which ensures a higher execution speed and smaller program size. By optimizing as many routines as possible without losing user friendliness, Notepad++ is trying to reduce the world carbon dioxide emissions. When using less CPU power, the PC can throttle down and reduce power consumption, resulting in a greener environment.

Notepad++ was developed by Don Ho in September 2003. The developer used JEXT (a Java-based text editor) at his company but, dissatisfied with its poor performance, he began to develop a text editor written in C++ with Scintilla. He developed it in his spare time since the idea was rejected by his company. Notepad++ was built as a Microsoft Windows application; the author considered, but rejected, the idea of using wx Widgets to port it to the Mac OS X and Unix platforms. Notepad++ was first released on Source Forge on 25 November 2003, as a Windows-only application. It is based on the Scintilla editor component, and is written in C++ with only Win32 API calls using only the STL to increase performance and reduce program size In January 2010 the US government obliged US-based open source project hosts to deny access from Cuba, Iran, North Korea, Sudan, and Syria to comply with U.S. law. As a response to what the developer felt was a violation of the free and open- source software (FOSS) philosophy, in June 2010 Notepad++ moved out of US territorial jurisdiction by releasing a version on Tux Family, in France. Some community services of Notepad++ (such as the forums and bug tracker) remained on Source forge until 2015 when Notepad++ left Source forge completely. In 2011 Lifehacker described Notepad++ as "The Best Programming Text Editor for Windows", stating that "if you prefer a simple, lightweight, and extensible programming plain-text editor, our first choice is the free, open- source Notepad++". Lifehacker criticized its user interface, stating that "It is, in fact, fairly ugly. Luckily you can do a lot to customize its looks and what it lacks in polish, it makes up for in functionality". In 2014 Lifehacker readers voted Notepad++ as the "Most Popular Text Editor", with 40% of the 16,294 respondents specifying it as their most- loved editor. The Lifehacker team summarized the program as being "fast, flexible, feature-packed, and completely free". In 2015 Stack Overflow conducted a worldwide Developer Survey, and Notepad++ was voted as the most used text editor worldwide with 34.7% of the 26,086 respondents claiming to use it daily. Stack Overflow noted that "The more things change, the more likely it is those things are written in JavaScript with NotePad++ on a Windows machine". The 2016 survey had Notepad++ at 35.6%.In 2015, in response to the staff hijacking of projects hosted on Source Forge, Notepad++ left Source Forge completely with the forums being moved to Node BB and the bug tracker to GitHub.

4.1.3Jupyter

The Jupyter Notebook[9] is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modelling, data visualization, machine learning, and much more. Notebook documents contains the inputs and outputs of a interactive session as well as additional text that accompanies the code but is not meant for execution. In this way, notebook files can serve as a complete computational record of a session, interleaving executable code with explanatory text, mathematics, and rich representations resulting objects. These documents are internally JSON files and are saved with the

Notebooks may be exported to a range of static formats, including HTML (for example, for blog posts), restructured Text, LaTeX, PDF, and slide shows, via the n b convert command. Furthermore, any .ipynb notebook document available from a public URL can be shared via the Jupyter Viewer

<nbviewer>. This serviceloads the notebook document from the URL and renders it as a static web page. The results may thus be shared with a colleague, or as a public blog post, without other users needing to install the Jupyter notebook themselves. In effect, nbviewer is simply nbconvert as a web service, so you can do your own static conversions with nbconvert, without relying on nbviewer.

4.1.4Jupyter Features

1.Language of choice: Jupyter supports over 40 programming languages, including Python, R, Julia, and Scala.
2.Share notebooks: Notebooks can be shared with others using email, Dropbox, GitHub and the Jupyter Notebook Viewer
3.Interactive output: Your code can produce rich, interactive output: HTML[8], images, videos, LaTeX, and custom MIME types.
4.Big data integration: Leverage big data tools, such as Apache Spark, from Python, R and Scala. Explore that same data with pandas, scikit- learn, ggplot2, TensorFlow.
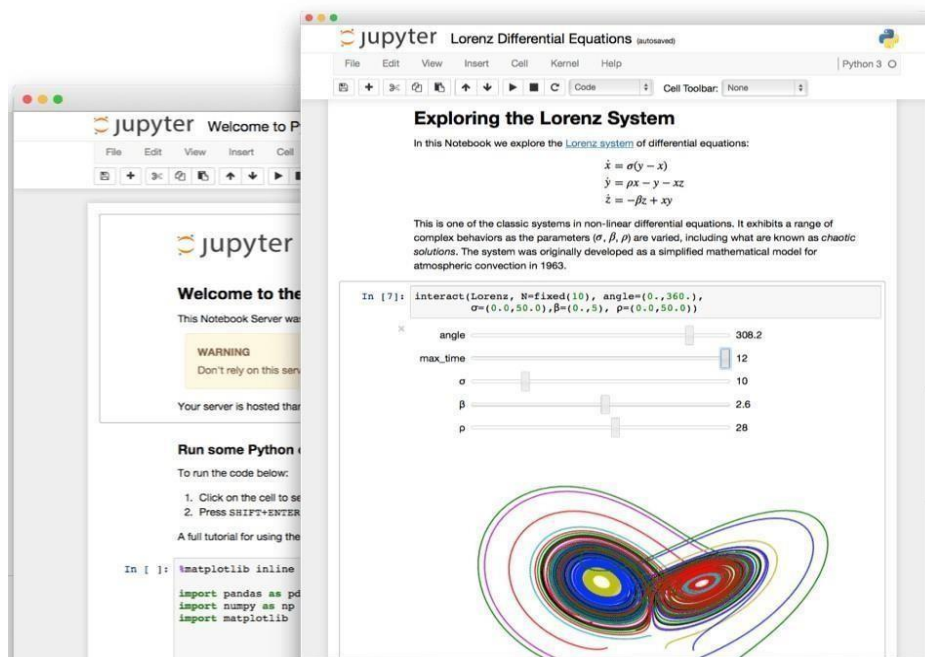

Figure4.1.3: jupyter network screen

4.2DEVELOPMENT TOOLS AND TECHNOLOGIES:

4.2.1PYTHON:

Python is an interpreter, interactive, object-oriented programming language. It incorporates modules, exceptions, dynamic typing, very high level dynamic data types, and classes. Python combines remarkable power with very clear syntax. It has interfaces to many system calls and libraries, as well as to various window systems, and is extensible in C or C++.

4.2.2 Python is portable

it runs on many Unix variants, on the Mac, and on Windows 2000 and later. When he began implementing Python, Guido van Rossum was also reading the published scripts from "Monty Python's Flying Circus", a BBC comedy series from the 1970s. Van Rossum thought he needed a name that was short, unique, and slightly mysterious, so he decided to call the language Python.

Python is one of those rare languages which can claim to be both simple and powerful. You will find yourself pleasantly surprised to see how easy it is to concentrate on the solution to the problem rather than the syntax and structure of the language you are programming in. Python is simple and minimalistic language. Reading a good Python program feels almost like reading English, although very strict English! This pseudo- code nature of Python is one of its greatest strengths. It allows you to concentrate on the solution to the problem rather than the language itself. Due to its open-source nature, Python has been ported to (i.e., changed to make it work on) many platforms. All your Python programs can work on any of these platforms without requiring any changes at all if you are careful enough to avoid any system-dependent features.

5MODULE DESCRIPTION

There are two modules in this project.

•Training Data

•Detection Mask

Training Data: We choose Supervised Learning to train the data. Since most of the project outcome depends on how we train the data along with the consideration of accuracy, time, delay and other factors which improves the training model to be more efficient. In this first module the entire image dataset is trained. So the project is Data Centric.

We first download the image dataset from Kaggle. There are categorised into 2 types:

a) Images with person with face mask

b) Images with person without face mask

the dataset size is more than or equal to 1000 i.e 1000 of each category.

Next we need to train those images in training module with respective factors such as epoch, batch size, learning rate. It is based on the size of sample we need to define those factors

For our project

•Epoch =20

•Batch size=3

•Initial learning rate is 1e-4 (1/10000) or 0.0001

We found the image dataset from Kaggle and downloaded 1000 images for each category

•1000 image of with mask

•1000 images of without mask i.e. normal faces of human.

DETECTION MASK

•If it is mask: it will show confidence numeric value (eg:99.0% person wearing mask)

•If it is no mask: it will show confidence numeric value (eg:99.0% person not wearing mask)

By detecting a person whether he is wearing a mask or not. Based on the trained data the output will be given the trained data to be more distinct. The output is accurate every time irrespective of Race, Skin colour, Gender

•**Racially Distinct:** Asian, African, American, Caucasian, etc

•**Skin Colour**: Black, Brown, white, Whitish, etc

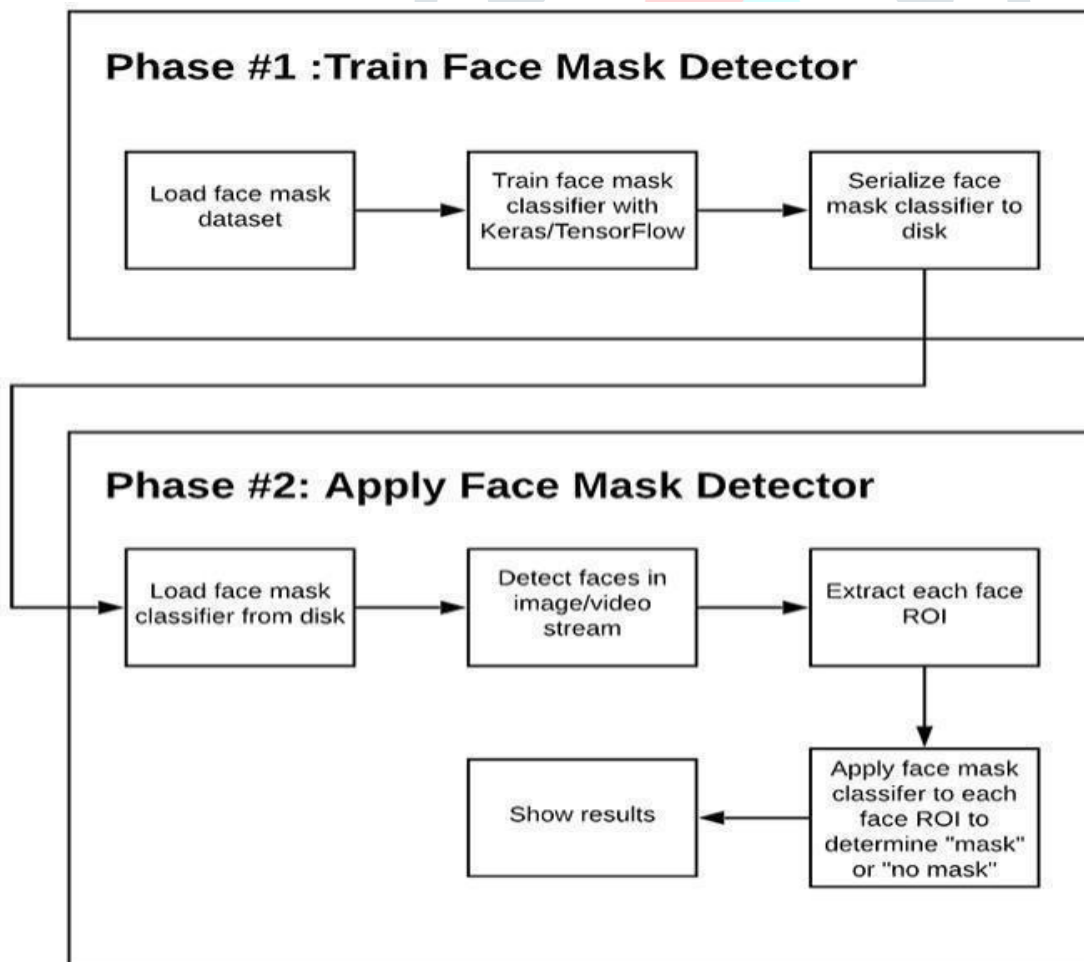•**Gender:** Male, Female

5.1ARCHITECTURE

Figure5.1 : ARCHITECTURE of face mask detector
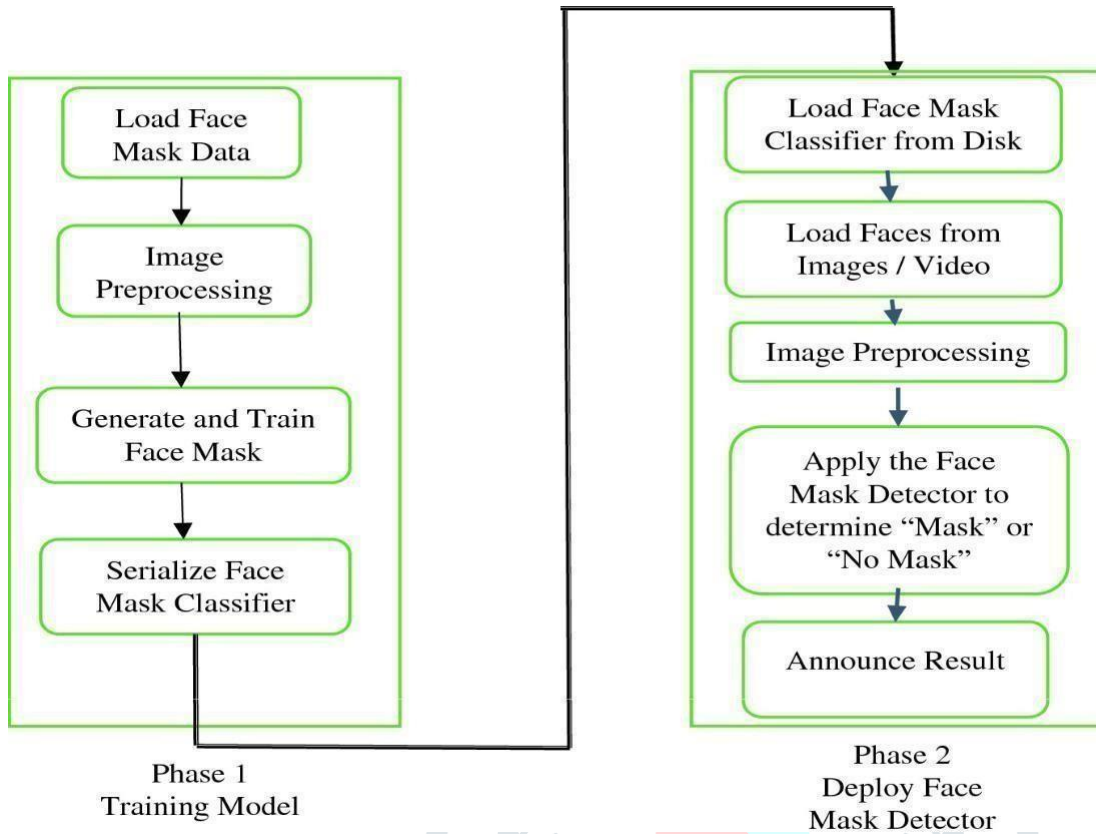
5.2DATA FLOW DIAGRAMS

Figure5.2: data flow diagram

5.3Things in UML

Things are the abstractions that are first-class citizens in a model; relationships tie these things together; diagrams group interesting collections of things.

There are four kinds of things in the UML:

•Structural hings

•Behavioral things[10]

•Grouping things

•An notational things

Structural things are the nouns of UML models. The structural things used in the project design are:

First, a class is a description of a set of objects that share the same attributes, operations, relationships and semantics.
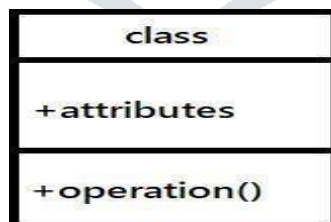
Figure5.3: Classes

Second, a use case is a description of set of sequence of actions that a system performs that yields an observable result of value to particular actor.
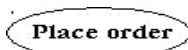
Figure5.3.1: Use Cases

Third, a node is a physical element [20] that exists at runtime and represents a computational resource, generally having at least some memory and often processing capabilit
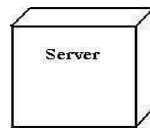
Figure5.3.2: Nodes

Behavioural things are the dynamic parts of UML models. The behavioural thing used is: Interaction:An interaction is a behavior that comprises a set of messages exchanged among a set of objects within a particular context to accomplish a specific purpose. An interaction involves a number of other elements, including messages, action sequences (the behavior invoked by a message, and links (the connection between objects)

5.4Relationships in UML
There are four kinds of relationships in the UML:
•Dependency
•Association
•Generalization
•Realization
A dependency is a semantic relationship between two things in which a change to one thing may affect the semantics of the otherthing (the dependent thing)

Figure5.4: Dependencies

An association is a structural relationship that describes a set links, a link being a connection among objects. Aggregation is a special kind of association, representing astructural relationship[14] between a whole and its parts.

Figure5.4.1: Association

A generalization is a specialization/ generalization relationship in which objects of the specialized element (the child) are substitutable for objects of the generalized element (the parent).

Figure5.4.2: Generalization

A realization is a semantic relationship between classifiers, where in one classifier specifies a contract that another classifier guarantees to carry out.

Figure5.4.3: Realization

5.5TRAINING GRAPH
Epoch is the number of passes over the data. Loss is the error over the training set typically in terms of mean squared error (for regression) or log loss (for classification).During an epoch, the loss function is calculated across every data items and it is guaranteed to give the quantitative loss measure[11] at the given epoch. But plotting curve across iterations only gives the loss on a subset of the entire dataset Using the best common value data points and batch size the graph is designed. The epoch value is 20, i.e the number of passes are 20 times over the data. And the batch size is 32 with respect to the dataset. A realization is a semantic relationship between classifiers, where in one classifier specifies a contract that another classifier guarantees to carry out. curve across iterations only gives the loss on a subset of the entire dataset Using the best common value data points and batch size the graph is designed.

6SYSTEM IMPLEMENTATION
Systems implementation is the process of:
1.defining how the information system should be built (i.e., physical system design),
2.ensuring that the information system is operational and used,
3.ensuring that the information system meets quality standard (i.e., quality assurance) is the number of passes over the data. Loss is the error over the training set typically in terms of mean squared error (for regression) or log loss (for classification).

6.1PURPOSE

During an epoch, the loss function is calculated across every data items and it is guaranteed to give the quantitative loss measure at the given epoch. But plotting curve across iterations only gives the loss on a subset of the entire dataset.

The purpose of System Implementation can be summarized as follows:

making the new system available to a prepared set of users (the deployment), and positioning on-going support and maintenance of the system within the Performing Organization (the transition). At a finer level of detail, deploying the system consists of executing all steps necessary to educate the Consumers on the use of the new system, placing the newly developed system into production, confirming that all data required at the start of operations is available and accurate,

6.2SYSTEM MAINTENANCE

Software Maintenance is the process of modifying a software product after it has been delivered to the customer. The main purpose of software maintenance is to modify and update software application after delivery to correct faults and to improve performance.

Need for Maintenance –

Software Maintenance must be performed in order to:

•Correct faults.

•Improve the design.

•Implement enhancements.

•Interface with other systems.

•Accommodate programs so that different hardware, software, system features, and telecommunications facilities can be used.

•Migrate legacy software.

•Retire software.

Categories of Software Maintenance –Maintenance can be divided into the following:

1.CORRECTIVE MAINTENANCE

Corrective maintenance of a software product may be essential either to rectify some bugs observed while the system is in use, or to enhance the performance of the system.

2.ADAPTIVE MAINTENANCE

This includes modifications and updations when the customers need the product to run

on new platforms, on new operating systems, or when they need the product to interface

with new hardware and software.

This type of maintenance includes modifications and updations to prevent future problems of the software. It goals to attend problems, which are not significant at this moment but may cause serious issues in future.

Software Reverse Engineering[15] is the process of recovering the design and the requirements specification of a product from an analysis of it's code. Reverse Engineering is becoming important, since several existing software products, lack proper documentation[13], are highly unstructured, or their structure has degraded through a series of maintenance efforts.

7.TESTING

demonstrates that the software functions Software testing[12] is a critical element of software quality assurance and represents the ultimate review of specifications, design and coding .The user tests the developed system and changes are made according to their needs.

Testing is a process, which reveals errors

in the program. It is the major quality measure employed during software development.

During testing the program is executed with a set of test cases and the output of the program for the test cases is evaluated to determine if the program is performing as it is expected to perform. When a system is developed, it is a hoped that it performs properly. In practice however some errors always occur. The main purpose of testing an information system is to find the errors and correct them. A successful test is one that found an error. The main objectives of the system testing are

•To ensure during operation the system will perform as per specification.

•To make sure that the system meets user requirements during operation.

•To verify that the controls incorporated in the system function as intended.

•To see that when correct inputs are fed to the system and the Outputs are correct.

•To make sure that during operation, incorrect input processing and output will be deleted.

If the testing is conducted successfully, it will uncover errors in the software. As a secondary benefit, testing appear to be working according to specification and that performance requirements appear to have been made.

7.1 Validation Testing

Validation Testing is the process of ensuring if the tested and developed software satisfies the client /user needs. The business requirement scenarios have to be tested in detail. All the critical functionalities of an application must be tested here. As a tester, you need to evaluate if the test execution results comply with that mentioned in the requirements document. Any deviation should be reported immediately and that deviation is thus called a bug. The business requirement scenarios have to be tested in detail. All the critical functionalities of an application must be tested here.

7.2 Acceptance Testing

redelivery testing in which entire system is tested at clients site on real world data to find errors. This testing is also called as Formal testing with respect to user needs and requirements, and business processes conducted to determine whether or not a system satisfies the acceptance criteria and to enable the user and customers or authorized entity to determine also called as Formal testing with respect to user needs and requirements, and business processes conducted to determine whether or not a system It is a level of software testing where system is tested for acceptability. The purpose of this testing is to evaluate the systems compliance with the business requirements and assess whether it is acceptable for delivery. It is a redelivery testing in which entire system is tested at clients site on real world data to find errors. This testing is also called as Formal testing with respect to user needs and requirements, and business processes conducted to determine whether or not a system satisfies the acceptance criteria and to enable the user and customers or the systems compliance with the business requirements and assess whether it is acceptable for delivery. It is a satisfies the acceptance criteria[18] and to enable the user and customers or authorized entity to determine

whether or not to accept the system.

S.NO	TEST CASES	ACTUAL RESULTS	EXPECTED RESULTS	PASS/FAIL
1	Training the images of without mask	Dataset Category Successfully Trained	Dataset Category Trained Successfully	PASS
2	Training the images of with mask	Dataset Category Successfully Trained	Dataset Category Successfully Trained	PASS
3	Accessing the System Camera	Successfully Accessed	Successfully Accessed	PASS
4	Evaluate the output for person wearing mask	Output shown as Mask	Output shown as Mask	PASS
5	Evaluate the output for person not wearing mask	Output shown as No Mask	Output shown as No Mask	PASS
6	Show numerical data prediction for person wearing mask	Showed up to 100% If yes	Showed up to 100% If yes	PASS
7	Show numerical data prediction for person not wearing mask	Showed up to 100% If yes	Showed up to 100% If yes	PASS

Figure7:test case table

8.TRAINING MODULE

Figure8: training module
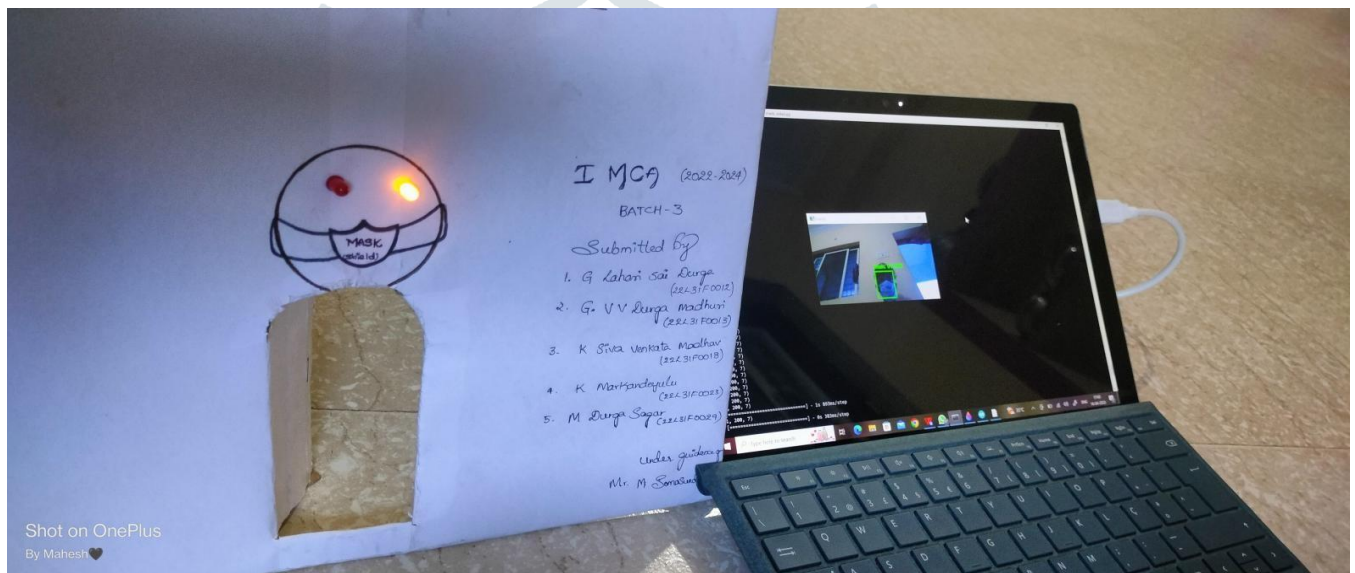
8.1. DETECTION MODULE

Figure8.1: detection module

9.REAL TIME TEASTING
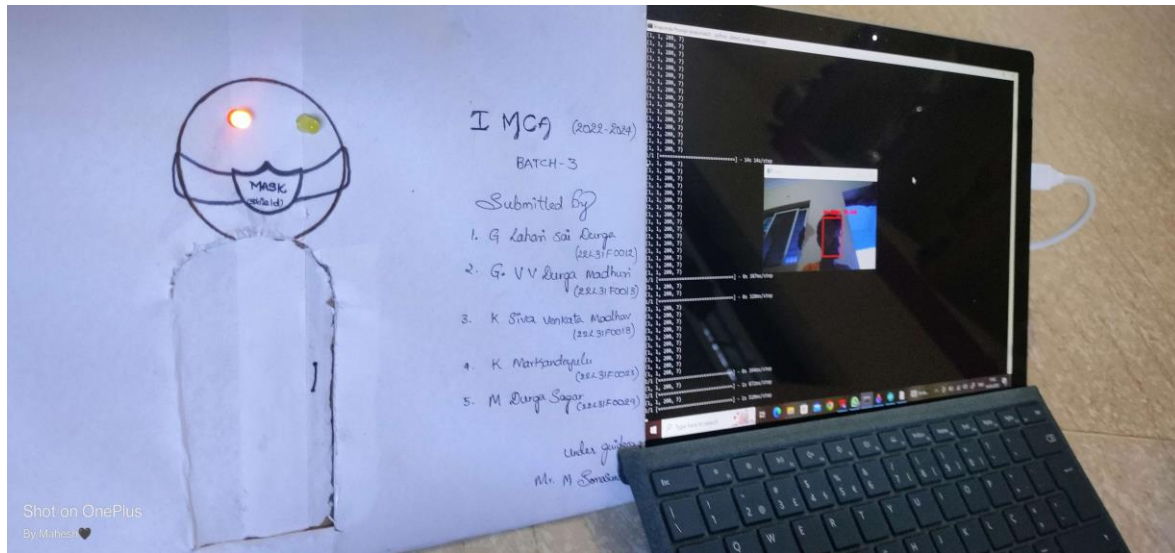
Figure9: No Mask Output

Figure9.1: With Mask Output

10.CONCLUSION

The experimental analysis shows that the proposed method can be successfully exploited for face mask violation detection. It is a real time software application which can be deployed in smart cc tv surveillance, public areas like airports, malls, etc where mask is necessary. Only the software it can be extensible to work along with other IOT devices to deny permit or closing doors at corporate office Moreover, we highlight that it is working also on device with limited computational capability and it is able to process in real time images and video streams, making our proposal applicable in the real world. Taking in to account above mentioned details, we can make the conclusion that the Mask detection project works in real time and be very useful in present situation. This application is build using python, python IDLE.

10.1. SCOPE FOR FUTURE DEVELOPMENT

The project has a very vast scopein future The project can be implemented in future. Project can be updated in near future as and when requirement for the same arises, as it is very flexible in terms of expansion. With this mask detection project we can stop the entry of people without mask into any public areas as everything can be automated. These can be useful for traffic police as well to easily detected people not wear or improperly wearing a mask.

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