Health Center Automation System Using Modified Deep Learning Model

Ekta Lal[1], Anindita Banerjee[2], Archit Dehloo[3], Vaibhav Saxena[4]
[1,2,3.4] Vellore Institute of technology

Abstract- *As of this day, AI is becoming a vital part of our everyday life. We may not even realize this, but we are constantly surrounded and assisted by automation and AI. Our design works on the idea of independent automation comprised of various sub-systems working in unison to create the final product. Our main idea is simple – to improve the management of the Health Centre (and also keep an option of expanding into larger hospitals). We plan on using features like machine learning, Arduino programming, RFID scanner & chips, facial recognition, optical character recognition, speech Recognition to design an asynchronous and self-sufficient system based on the Object-Oriented Programming concept.We have implemented real-time Face Detection with a tracking feature. Our system will use a pre-installed camera to identify the person entering the health center and assign them a token number to proceed in the waiting area. Another camera in the waiting zone will track the number of people inside.We have implemented an automated appointer & counters in this system. RFID Scanners & Camera are used to check the number of people in the waiting room and schedule their instant appointment with the doctor as they walk into the health center. All they need to do is scan their ID card / Show their face to the camera.We have included a consent-based automated system that can listen and transcribe the entire conversation between the doctor and the patient and add it to the meeting logs in the database for reference. Thus, acting as a real-Time Conversation Transcribing feature.We have used web scraping and database management system with intelligent text analysis systems. This feature will send reminders to the patients regarding their medicines and monthly health center visit summary, acting as a remote reminder and summary system.*

Keywords- ARTIFICIAL INTELLIGENCE, HEALTHCARE SYSTEM, ARDUINO, MACHINE LEARNING, FACIAL RECOGNITION, DEEP LEARNING

I. INTRODUCTION

Our base idea is simple we want to improve the management of the Health Centre (and also keep an option of expanding into bigger hospitals. The sole purpose of doing this project is to make a Health care optimization system that can be applied to Real World Hospitals. We plan on using:

- Machine Learning
- Deep Learning
- Arduino programming
- RFID Scanner and Chips
- Optical Character Recognition
- Speech Recognition

among other features and elements to design a synchronous and self-sufficient system.

The main issue we are trying to counter is the inefficiency caused by only using human factor in highly repetitive tasks. We will be solving this by including automation along with a host of other features. We aim to automate as much of the process as we can to make the system simpler to use and also improve the overall stability and scalability of the same. So, at the end of our project, we are aiming to manage the different tasks of health-center efficiently and now that we know that the tasks like database management is handled automatically there is a very little or no window for errors.

Our idea is to essentially streamline the entire process from patient registration to reminding patients on a timely medicine for the same and also maintain database of their health records. The proposed idea of ours while doing the aforementioned also is quick and highly accurate with the face recognition models capable of running with minimal dataset images for the training. We also have thought of making our project cost-effective so that not only the high-end centers but also the centers that have a lower budget are able to use the system. The entire module in itself is highly customizable making is relatively simple to upgrade the system and add additional modules such as encryption modules and other modifications to expand and improve system performance.

II. RELATED WORKS

[1] The development of a system for recognizing persons from images, even while they are wearing a face mask, is described in this manuscript. The OpenCv face detector is used in conjunction with a classification model

based on the MobileNetV2 architecture.[2] Here they have explained how clinicians actually work, provide recommendations on creating or selecting clinical computer systems, and investigate how the usage of electronic health records would affect patient care.[3] In this paper, we describe a method for detecting electronic identification cards that combines image processing and optical character recognition (OCR). As a result of our image processing algorithms and OCR, we can recognize ID cards with a 98 percent accuracy.[4] To detect instantaneous people count, this article presents a CNN-based people counter that identifies a given frame cube to a specific event that signifies people arriving or exiting a target area.[5] Using LoCATE, supervisors may view the position of doctors, patients, and assets within the business in real time using a web UI or a mobile app. The obtained data is then evaluated to uncover inefficiencies in daily operations and improve the health-care system, which is saved and processed on a Cloud Storage platform.[6] The purpose of this paper is to offer a method for transcribing doctor-patient discussion that reflects the consultation's interactional processes.[7] The use of modern Computer Vision Technology to eliminate printed prescriptions and physical components such as RFID, Record Files is proposed in this study. A database linked to a patient's face image can be installed on a secure platform that can be updated on a regular basis and will be widely accepted as the basis of patient identity.[8] Here they have used the SSDMNV2 technique where they use Single Shot Multibox Detector as a face detector and MobilenetV2 architecture as a structure for the classifier, it's a framework which doesn't need high specifications to run and can easily be with embedded devices to perform mask detection.[9] This article covers the data that is currently accessible in the UDB, explains the two techniques for automatically creating reports from this data, and displays examples of inline text, figures, and tables created using both methods.[10] The goal of this study was to see how a computer-based patient record system affected people's thinking. Computer-based patient record systems are "cognitive artifacts," influencing how health-care professionals acquire, organize, and reason with information.

Florentino et al. [11] proposed the concept of automating a hospital's clinical laboratory. In their system, they used RFID tags and contactless smart cards. Patients and hospital workers are verified through this effort. Face identification using deep learning has been explored by X. Han et al [12]. This project combines deep learning, facial recognition technology, and depth learning order. Nwosu et al. [13] have attempted to address the global medical emergency situation. They experimented with facial recognition on mobile devices. They've put this method's viability to the test. This effort will be a cost-effective solution that will also be valuable for patient registration. Phua et al. [14] developed an NFC-based system that sends signals to nurses and hospital workers to perform a series of steps in order to clear the bed for occupancy. Dias et al. [15] presented a system that reduces patient wait times, hence preventing hospital catastrophes caused by congestion. Each unit's patients are balanced using an automated management system. Preeti Nagrath et al. [16] proposed the use of MobileNETv2 and Single Shot Multibox Detector to detect face masks easily and quickly, with the approach being able to be deployed in Embedded Devices, which is very useful for the way we are suggesting. Liang et al. [17] To construct a smart campus with health monitoring as part of creating a safer city environment, researchers used the HL7, AMQP, and RabbitMQ protocols. The client's system includes real-time alarms and monitoring. Jignesh Chowdary G et al. [18] For hospital administration in smart cities, they have proposed a new traceable patient health data search system. At the grain of the hospital bed, the system manager distributes encrypted patient health data to several doctors. From the patient health monitoring data, each doctor precisely finds a patient with a unique trait. Olutosin Taiwo et al. [19] offered a means for doctors to distribute prescriptions to patients remotely via a self-designed system, in order to assist restrict the spread of new coronaviruses by minimizing exposure. Xing Wu et al. [20] advocated using Inception-ResNet Face Embedding (IRFE) for their face identification technique, which provided higher efficiency and accuracy than each model could achieve on its own. For feature extraction from the ID cards, they used Morphology Transformed Feature Mapping (MTFM).

III. DESIGN AND METHODOLOGY OF HEALTH CENTER AUTOMATION SYSTEM

Besides advances in medical devices and medicine, another technological advancement is changing healthcare: Automation. All of us want greater efficiency and effectiveness in healthcare. We all want to experience the most advanced systems and strategies available. And we all aspire consistently superior outcomes. In healthcare, automation could seem like reminder messages that remind patients of their appointments in the hospitals. Or automation could invoke a database that detects and notifies patients of known diseases and respective medications. In this paper, we have added many other features apart from these regular ones that will be a boon to the health care systems of our society.

In our very first script where we are taking the photo of the student entering into the health centre there, we are using OpenCV to capture the image of the person and save that image in a folder.

3.1 Database generation

From our source, we collected an excel sheet of dataset of all students. With this database, we created individual CSV files under each registration number. These files were then saved in the required folder automatically.

3.2 Face Mask detector

Getting to the case where the person is wearing a mask while entering into the health centre. The face mask detector goes to the source folder where the images from the screenshot taker are saved, takes the image and runs the scan. If the mask is detected, it will prompt the user to use the alternate methods of registration which include OCR, RFID scanning or retry taking the image.

If the mask is not detected, it will get you directly to the face recognition script. So essentially, the mask detection runs on top of face detection.

3.3 Facial Recognition

We have implemented a face recognition system in our project at two sites. One is at the very entrance of the health centre and the second at the lobby of the doctor's cabin. We have tested face recognition on a pre-trained model called MobileNETv2. The camera at the door entrance of the health centre captures the pictures of the person to be recognized. In this script, we go to the folder directory of the camera captured photos and fetch the most recent photo. Thus, performing facial recognition of the person.

After setting the initial conditions and loading the image of the person from the source folder, this script will check for a PNG image format file in the folder. If it can find the image in the source folder it displays the message "Image Found, Initializing the Face Mask Detector now.”

We then load the image, resize it to a width of 600 pixels (while maintaining the aspect ratio), and then take the image dimensions. We then construct a blob for the image. Now we apply OpenCV's deep learning-based face detector to localize faces in the input image and extract the face ROI. Ensuring the face width and height are sufficiently large, we perform classification to recognize the face. The bounding box of the face along with the associated probability is drawn. Thus, we print the name of the person identified. Now, as the person is identified, we call *TokenFileGenerator.token_giver(<patient_name>, <identification_number>)* and assign a token to that person so in the excel file where there is the column for the presence of a person inside the health centre(status), its field value will become “1” from the default “0”.

This script is to train the face recognition models. We have to run the script every time a new person is registered in the face recognition training database and not only that, but we have also applied reinforcement learning in our face recognition. So, every time you visit the health centre, our model will expand its training data and will become more efficient in recognizing your face. Once we get to the threshold of required training data, we can stop adding sample images to our training dataset.

3.4 OCR

Optical Character Recognition is used for automated processing of images. In our project, we are using OCR to detect if the image of id card taken by the camera is clear or not and then extract student details from that. This is to make sure that the image captured is clear or not, so that needed text is extracted successfully.

The basic approach is:

1. Use laplacian filter to find edges in the input image.
2. Calculate **variance** and **maximum** over the pixel values of filtered image
3. High variance suggests clearly edges, i.e.**sharp image**. Low variance suggests a blurred image.

Based on the focus measure, the image is classified as blurry or not blurry.

The basic function of this script is to take your image with the help of the camera installed at the entrance of health center.

3.5 TOKEN GENERATION

As soon as the image is taken by the system through the same or the user scanned their ID card or even used OCR, the software will extract their name and ID number in the latter or extract the details from the database in the former method of face mask detection. These details are then fed into another script which basically generates an appointment number for the user here, referred to as the token number. Now in case the user is the first patient for the day, a new file is generated for the same with the date and time-stamp, which makes it easier to maintain an extensive database of who visited the center and when.

Finally, when the user visits the doctor’s cabin an indicator variable that defines if the user has visited the doctor or not to avoid any “confusion” or repetition.

3.6 DOCTOR’S CABIN- PRIVILEDGES

In each individual CSV file in the folder, we have added a column named privileges. If the patient wants speech-to-text to work inside the doctor’s cabin, it is mentioned in this column. Otherwise, it will not work.

3.7 WEB SCRAPING

Web Scraping is an automated process to collect large quantities of data from websites. The greatest of this data is disorganized data in an HTML composition which is then transformed into structured data in a spreadsheet or a database to be used in different applications. There are several distinct approaches to perform web scraping to gather data from websites. These approaches are utilizing online services, particular API’s or even building your code for web scraping from scratch. Multiple large websites have API’s that enable you to access their data in a structured form. In situations where websites do not allow you to access data, it is best to use Web Scraping to scrape the website for data.

Web scraping needs two parts, the crawler and the scraper. The crawler is an artificial intelligence algorithm that scans the web to search the accurate data required. The scraper, on the other hand, is a particular tool created to obtain the data from the website. The design of the scraper can differ greatly according to the complexity and range of the project so that it can instantly and precisely extract the data. Web Scrapers can extract all the data on particular sites or the specific data that a user wants.

3.8 Open CV

OpenCV is a library utilized for computer vision, machine learning, and image processing and now also in real-time operation which is very important in today’s time. Using it, we can process images and videos to identify objects, faces, or even handwritings. When it integrated with other libraries, such as NumPy, python is capable of processing OpenCV array structure for analysis. To Identify image pattern and its features we use vector space and perform mathematical operations on these.

Thus, by OpenCV we are able to take the video input from our camera.

This is how our image gets saved into the designated folder from where we can use it for further actions.

3.9 Person Counter

In order to get the number of patients in the waiting Room we have designed a person counter that counts the number of people going inside, number of people coming out of the health centre and also the total number of people inside the waiting area of health centre.

The person counter we have designed is a python script that takes a input of real time camera footage or a video.

As it takes the input of the video it divides the video into hundreds of frames, and now that we are having frames of our video, we can apply a convolutional neural network on that to detect its various features.

The Model we are using here is MobileNET. This is pretrained model that we are using for our video input.

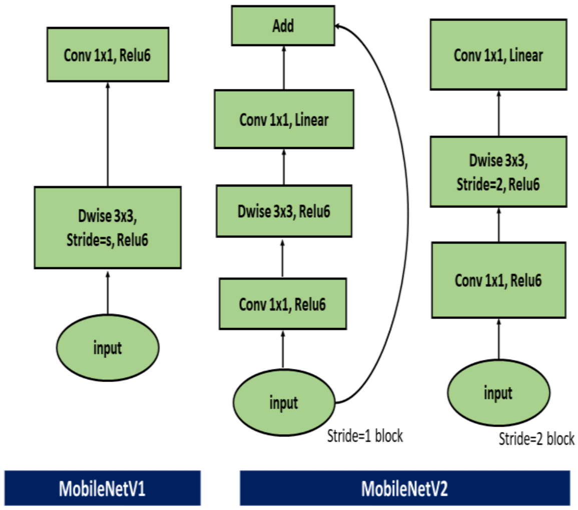
3.10 TEXT-TO-SPEECH

IV. MODELS

4.1 MobileNetV2

Starting with the previous version of MobileNetV2 that is MobileNet V1, depth wise separable Convolution is introduced which dramatically reduce the complexity cost and model size of the network, which is suitable to Mobile devices, or any devices with low computational power. In MobileNetV2, a better module is introduced with inverted residual structure. Non-linearities in narrow layers are removed this time. With MobileNetV2 as backbone for feature extraction, state-of-the-art performances are also achieved for object detection and semantic segmentation.

- In MobileNetV2, there are two types of blocks. One is residual block with stride of 1. Another one is block with stride of 2 for downsizing.
- There are 3 layers for both types of blocks.
- This time, the first layer is 1×1 convolution with ReLU6.
- The second layer is the depth-wise convolution.
- The third layer is another 1×1 convolution but without any non-linearity. It is claimed that if Relu is used again, the deep networks only have the power of a linear classifier on the non-zero volume part of the output domain.



Input	Operator	Output
$h+w+k$	1x1 conv2d, ReLU6	$h+w+(tk)$
$h+w+tk$	3x3 dwise S=s, ReLU6	$\frac{h}{s}+\frac{w}{s}+(tk)$
$\frac{h}{s}+\frac{w}{s}+tk$	Linear 1x1 conv2d	$\frac{h}{s}+\frac{w}{s}+k'$

- If the input got 64 channels, the internal output would get 64×*t*=64×6=384 channels.

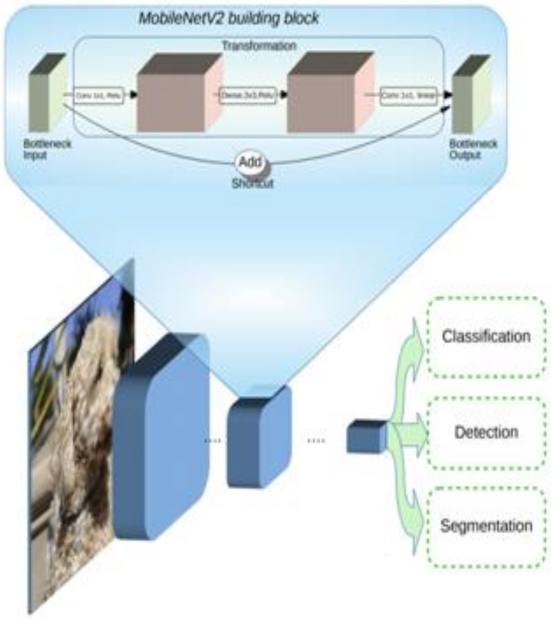


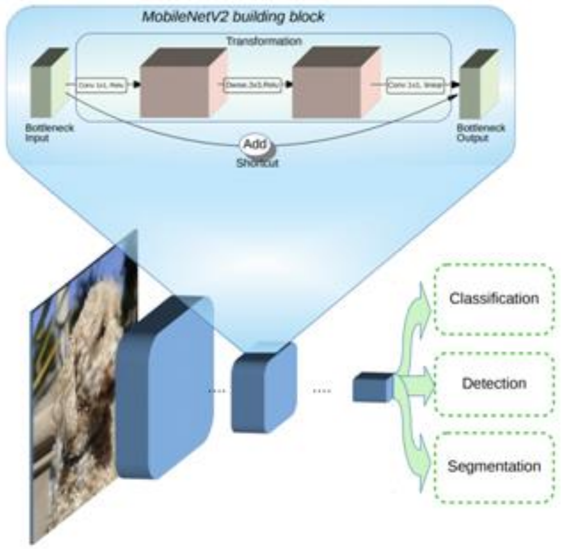
Fig. MobileNetV2 for Classification, Detection and Segmentation

Credit:https://ai.googleblog.com/2018/04/mobilenetv2-next-generation-of-on.html

Token File generator

Talking about the token file generator first the program will check if there is a folder named

18BECXXXX in the source folder, if not it will create a folder named 18BECXXXX and if the folder is already their then it would display the message *"folder already exists"*.



Now inside the .csv file named 18BECXXXX we will give attributes like Name, Registration number, time, Token Number and most important the Status.

Once all this is done, we will get the message that *"Today's token file generated"*

Database Generator (For patient Record purpose)

Now considering the fact that you were already identified at the main door and you were assigned a token successfully. Then you were also identified at the door for the Doctors cabin and your database is open Infront of the Doctor in the health Centre.

Now it will again check for some primary conditions, so if your database folder is already their it will fetch that if not, it will create one.

Now we can see we created a csv file named StudentData.csv we will give attributes in this file like Date, Diagnosis, Prescription, Privileges, Transcribed data, remarks.

We have also implemented a Realtime transcriber (between the patient and the Doctor) in our project so that one can remember the valuable advises that a doctor gives to a patient because it's always the case that we forgot this important conversation after some time.

So, inside the Column *"Transcribed data"* the information will get stored and now as its written and documented it available for you for your future reference also.

This Document will Automatically get to your mail by the application of Web Scraping which we have explained at the start of this document.

Data opener

Case 1: In this case we are using a camera and RFID for the second door that is the door for doctors' cabin. In this case we don't need to call auto data generator it has the capability of identifying and opening the required database on its own.

Case 2: The sole purpose of this case is to make our project more economical and more practical. So, in this case, we do not use a camera and RFID for the Second door instead we rely on the Token generator file for the tokens. So, in this case, the doctor will press a button as the patient enters the cabin. So, what our AutoData opener will do is that it will go to the status column of the token file and open the patient database of the first person whose status in the Token file id "0" and subsequently it will open for others

Open the file having the Token Numbers that have been assigned

So, it gets the first Registration number with the status "0".

Main runner

Now getting to the most important script of our project that is the Main Runner

This script act as bridge for the following scripts

- main runner
- main trainer
- auto data opener
- database generator
- pipeline screenshot to test
- screenshot taker
- token file generator
- token checker
- face recognition files
- extract embeddings
- recognize
- train model
- mask recognition files
- detect mask image
- train mask detector
- optical character recognition
- speech to text
- scrape Gmail

The reason we are able to combine these scripts is the ease that python offers.

This program runs the actual scripts in sequence
Checks if an image has been taken, if not, takes an image for further processing

Radio Frequency Identification

Radio Frequency Identification technology consists of two parts – a reader and a tag. RFID Reader or Scanner is a device which gathers information from an RFID tag, that is used to track individual items. The tag transfers data to the reader using radio waves. RFID technology in theory is similar to bar codes, other than the fact that the RFID tag does not have to be scanned directly. In order to read the data on the tag, the tag must be within the range of the reader, which is 3 to 300 feet. RFID technology allows multiple items to be scanned quickly and facilitates fast identification of a particular product, even when other items are surrounded by it.

There are two types of RFID tags. Passive tags are powered by energy from the RFID reader's interrogating radio waves. Active tags are powered by a battery and thus it can be read at a greater range from the RFID reader. All tags are encoded with digital data. The digital data is most commonly the unique ID of the tag.

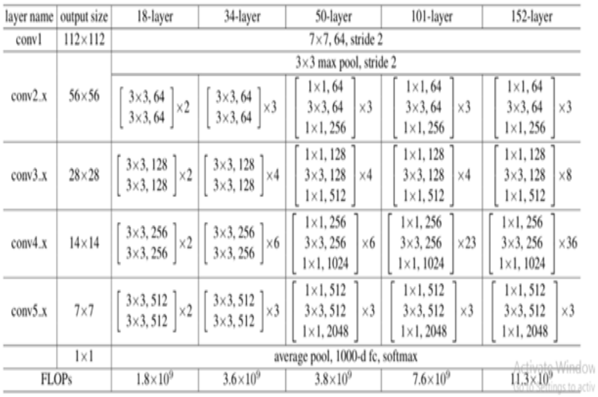
There are many RFID Readers but one of the most common is MFRC522. The RFID Reader can be connected to an Arduino. When the RFID tag is detected by the reader, the unique ID is received by the reader and saved in a string in the Arduino. This code saves the unique ID in the string 'tag'.

4.2 Resnet50

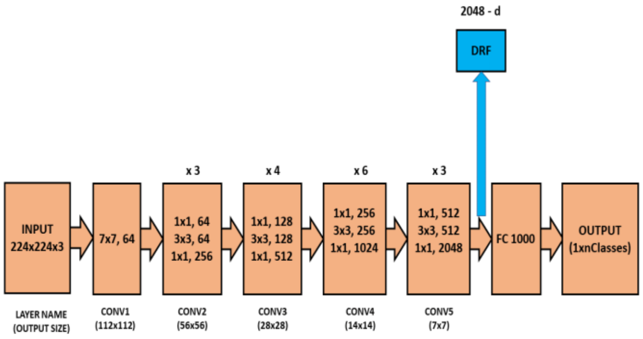
Inception is used to reduce the computational burden of the system. However, as we go deeper into the system, accuracy decreases. Inception focuses mainly on computational cost, while ResNet focuses on computational accuracy.

ResNet50 is the most used architecture and gives the best accuracy when compared to inception v2 and MobileNet v2. We have used the same in our system.

Architecture



layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112×112	7×7, 64, stride 2				
conv2_x	56×56	3×3 max pool, stride 2				
		$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$
conv3_x	28×28	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times8$
conv4_x	14×14	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times23$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times36$
conv5_x	7×7	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10^9	3.6×10^9	3.8×10^9	7.6×10^9	11.3×10^9



4.3 3D MODEL

Fig. 1 describes the 3D model of the proposed system. We have designed this 3D model using Adobe Dimension. Various components involved in this diagram are described in the following sections.

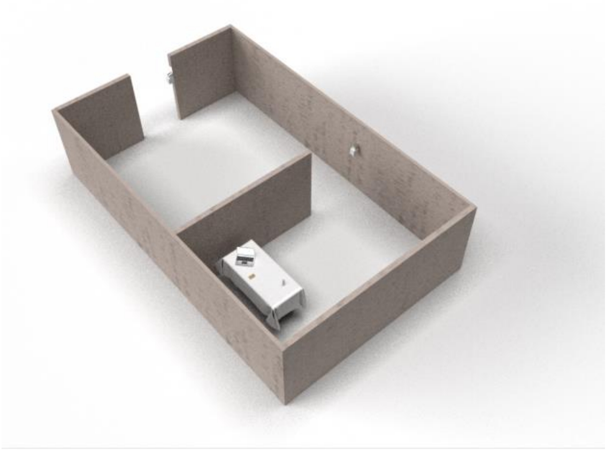


Figure 1: 3D model of the system

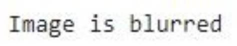
Door 1: Door 1 is the main entrance of the health center. It is equipped with a camera, an LCD screen and an RFID Scanner.

Door 2: Door 2 is the entrance to the doctor's cabin.
Door 2 is classified into two cases

- **Case 1(More Reliable): Case** one is when the second door is also equipped with an RFID scanner and a camera for face recognition.
- **Case 2(More economical): The** second case is when the second door does not have a camera and an RFID. Alternatively, the doctor uses a button to auto open the patient's record who enters the Doctors Cabin.

V. RESULTS AND DISCUSSION

In this paper, we present a completed software package that can improve the efficiency of a healthcare center or even a hospital along with the security. Also, it can help maintain a comprehensive database of everyday occurrences inside the premises. We have achieved all of this by maintaining and generating multiple programming scripts and software on multiple platforms, all integrated into one another to make a package that can have multiple methods of usage to improve the user experience. We aimed to develop a backend structure that handles the entirety of the processing and, we have achieved that easily.



```
Image is blurred
```

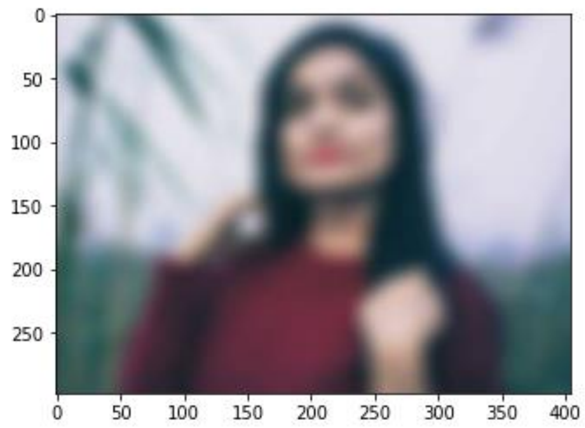


Figure 8: snapshot of blurred image detected

The focus measure of the above image is *83.17*, falling below our threshold of *100*; thus, we correctly mark this image as blurry.

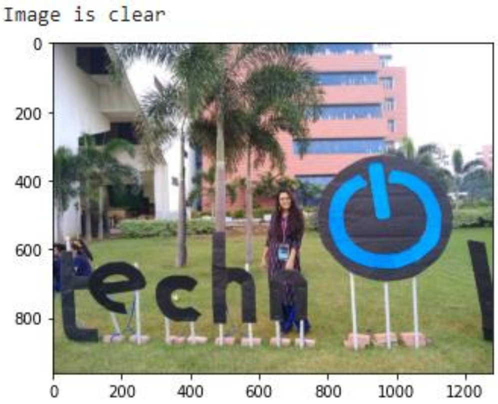
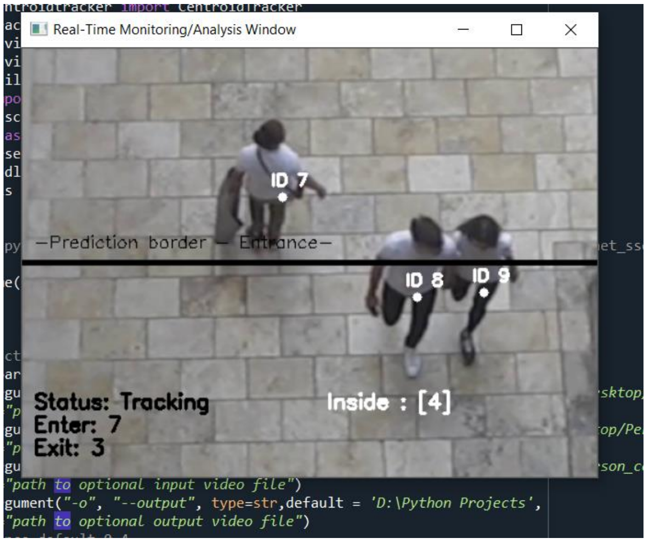


Figure 9: snapshot of clear image detected


Real-Time Monitoring/Analysis Window
ID 7
ID 8
ID 9
—Prediction border — Entrance—
Status: Tracking
Enter: 7
Exit: 3
Inside : [4]

```
ntroidtracker import CentroidTracker
"path to optional input video file")
gument("-o", "--output", type=str,default = 'D:\Python Projects',
"path to optional output video file")
```

Figure 10: snapshot of people detected in the waiting area

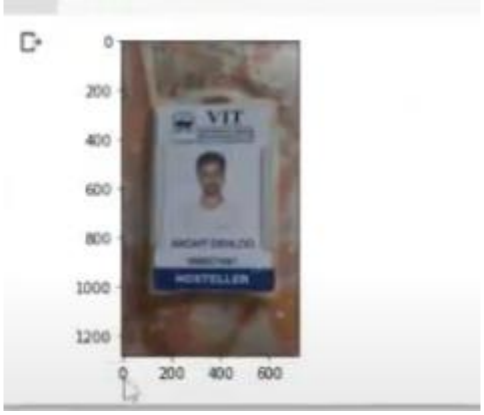


Figure 11: snapshot of ID card detected

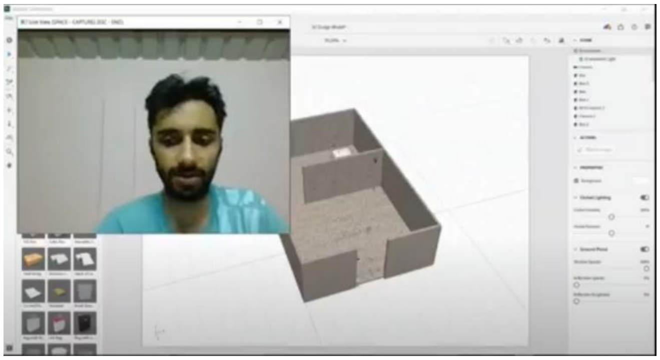
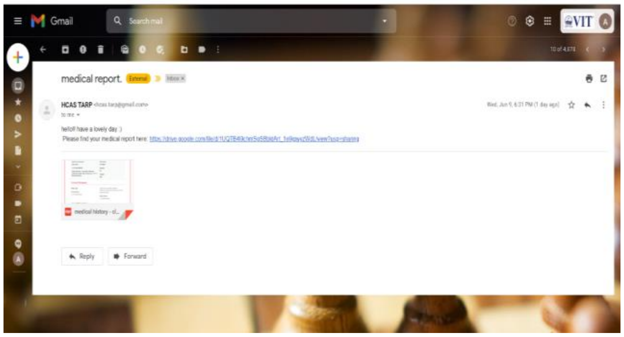


Figure 12: snapshot of face detection



medical report. External Inbox ×

HCAS TARP <hcas.tarp@gmail.com>

to me

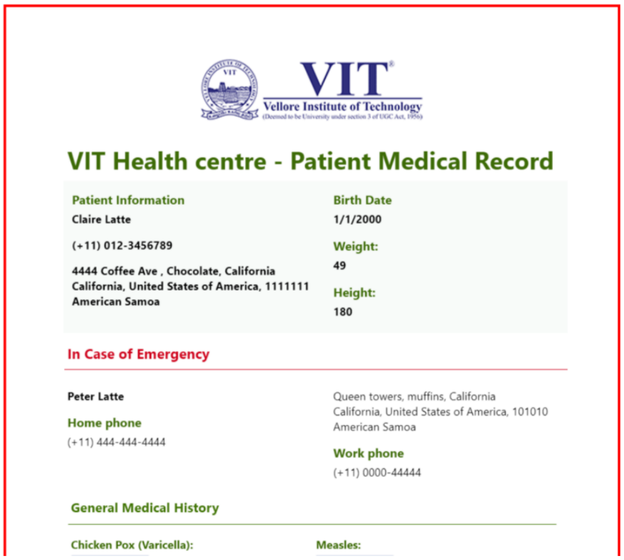
Wed, Jun 9, 6:31 PM (1 day ago)

hello!! have a lovely day :)

Please find your medical report here: https://drive.google.com/file/d/1UQTB49k[illegible]/view?usp=sharing

medical history - cl...

Figure 13: snapshot of the monthly medical report sent by auto running software



VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

VIT Health centre - Patient Medical Record

Patient Information	Birth Date
Claire Latte	1/1/2000
(+11) 012-3456789	Weight: 49
4444 Coffee Ave , Chocolate, California California, United States of America, 1111111 American Samoa	Height: 180

In Case of Emergency

Peter Latte

Home phone

(+11) 444-444-4444

Queen towers, muffins, California
California, United States of America, 101010
American Samoa

Work phone

(+11) 0000-44444

General Medical History

Chicken Pox (Varicella): Measles:

Figure 14: snapshot of the sample monthly medical report pdf

VI. CONCLUSION AND FUTURE SCOPE

So, finally we can conclude that the massive undertaking we had taken in the beginning of the semester has been realized to completion and the end result is a full-fledged software that is capable of running with multiple start points and generating a token number all within 3 seconds. One major achievement of our method is the comprehensive nature of the software meaning that we can expand them in any direction due to the implementation of Object-Oriented Programming in our system. And one major point of our project is that we have worked to include multiple aspects of Artificial Intelligence systems into our program ranging from speech to text using Speech recognition systems, Optical Character Recognition, Face Recognition all of which run on Deep Learning trained models and API's that are provided by Google and many other features. Also, the use of an optional end-branch in the form of a button or another RFID & Camera array in the end point when entering the Doctor's cabin means that we have adaptability in that section too and with the use of 3d modelling techniques we are able to provide a better understanding of our project in a whole.

The future scope of our project is vast. Our base idea was that we worked on the design of a software package in such a way that we are able to expand any aspect of it and even modify the same as and when necessary. Careful use of multiple scripts has paved the way for future expansion, addition of more methods in the start, addition of features such as those for security which can range from just keeping a check on the safety condition of the area using sensor arrays all the way to use of Augmented Reality to keep track of each and every person inside the waiting area along with a system setup for behavioral analysis and risk assessment systems in place. As was mentioned above we have worked on the development of the backend of the system and in the near future we can work on the development of a frontend system for our project in the form of a website or an app or even both.

REFERENCES

[1] Hospital Automation System RFID-Based: Technology Embedded In Smart Devices (Cards, Tags and Bracelets); Florentino, Gustavo HP, Carlos A. Paz de Araujo, Heitor U. Bezerra, B. de A. Helio, Marcelo Araujo Xavier, Vinícius SV de Souza, Ricardo A. de M. Valentim, Antonio HF Morais, Ana MG Guerreiro, and Glaucio B. Brandao. "Hospital automation system RFID-based: technology embedded in smart devices (cards, tags and bracelets)." In *2008 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, pp. 1455-1458. IEEE, 2008.

[2] Research on face recognition based on deep learning; X. Han and Q. Du, "Research on face recognition based on deep learning," 2018 Sixth International Conference on Digital Information, Networking, and Wireless Communications (DINWC), 2018, pp. 53-58, doi: 10.1109/DINWC.2018.8356995.

[3] Mobile Facial Recognition System for Patient Identification in Medical Emergencies for Developing Economies; Nwosu, Kingsley C. "Mobile Facial Recognition System for Patient Identification in Medical Emergencies for Developing Economies." (2016).

[4] NFC-based Smart Notification System for Hospital Discharge Process and Bed Management; Phua, Wei Jie, Malcolm Yoke Hean Low, NeelakantamVenkatarayalu, and Jared Koh. "NFC-based smart notification system for hospital discharge process and bed management." In *2018 IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI)*, pp. 143-147. IEEE, 2018.

[5] SIGTE: A System for Management of Waiting Time in Hospital Emergencies; Dias, Lucas Pfeiffer Salomao, Mateus Raeder, and Jorge Luis Victoria Barbosa. "SIGTE: a system for management of waiting time in hospital emergencies." *IEEE Latin America Transactions* 16, no. 2 (2018): 668-676.

[6] SSDMNV2: A real time DNN-based face mask detection system using single shot multibox detector and MobileNetV2; Preeti Nagrath, Rachna Jain, Agam Madan, Rohan Arora, Piyush Kataria, Jude Hemanth,SSDMNV2: A real time DNN-based face mask detection system using single shot multibox detector and MobileNetV2, Sustainable Cities and Society, Volume 66, 2021, 102692, ISSN 2210-6707

[7] Intelligent and Real-Time Data Acquisition for Medical Monitoring in Smart Campus; Liang, Yi, and Zixi Chen. "Intelligent and real-time data acquisition for medical monitoring in smart campus." *IEEE Access* 6 (2018): 74836-74846.

[8] Face Mask Detection Using Transfer Learning of InceptionV3; Jignesh Chowdary G., Punn N.S., Sonbhadra S.K., Agarwal S. (2020) Face Mask Detection Using Transfer Learning of InceptionV3. In: Bellatreche L., Goyal V., Fujita H., Mondal A., Reddy P.K. (eds) Big Data Analytics. BDA 2020. Lecture Notes in Computer Science, vol 12581. Springer, Cham. https://doi.org/10.1007/978-3-030-66665-1_6

[9] Smart healthcare support for remote patient monitoring during covid-19 quarantine; Taiwo, Olutosin, and Absalom E. Ezugwu. "Smart healthcare support for remote patient monitoring during covid-19 quarantine." *Informatics in medicine unlocked* 20 (2020): 100428.

[10] Identity authentication on mobile devices using face verification and ID image recognition; Wu, Xing, Jianxing Xu, Jianjia Wang, Yufeng Li, Weimin Li, and Yike Guo. "Identity authentication on mobile devices using face verification and ID image recognition." *Procedia Computer Science* 162 (2019): 932-939.

[11] http://webmail.inb.uni-luebeck.de/inb-publications/pdfs/KhJuMuMu20.pdf

[12] https://ai.googleblog.com/2018/04/mobilenetv2-next-generation-of-on.html