NON INVASIVE PUBLIC SAFETY DETECTION SYSTEM

INFOSYS SUMMER OF IDEAS
TEAM NAME: NP3M

TEAM DETAILS

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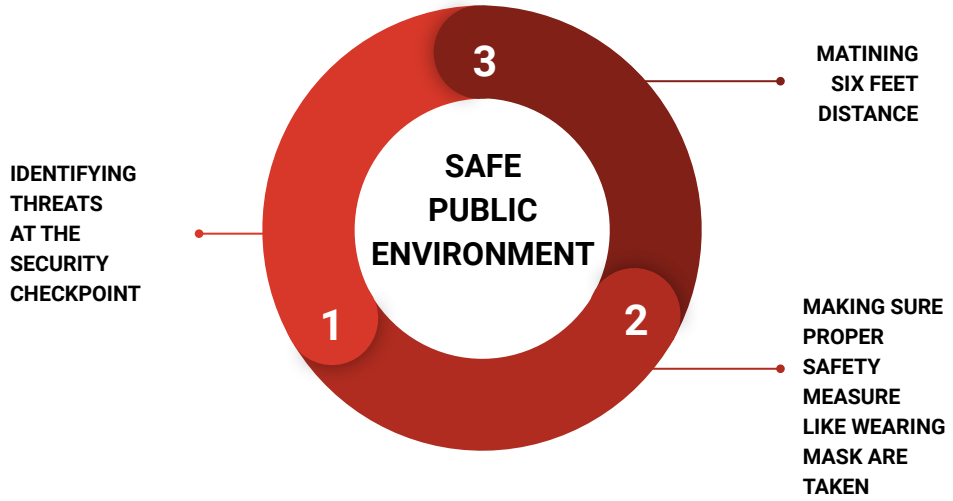
PROBLEM STATEMENT

- Even after the Covid-19 Situation is under control ,various essential preventive measures should be taken.
- There are high chances of another outbreak or relapse of Covid -19 if strict measures regarding health checking are not taken.
- Hence taking measures at public places ,offices etc becomes very crucial for the safety of the individuals.



SOLUTION ABSTRACT

- We are proposing a **Contactless non invasive safety detection system** that assess various parameters in order to **permit only healthy and precautious individuals.**
- Various safety measures like **Mask and PPO kit detection** can be done according to needs.
- Heath parameters like **fever , coughing ,runny nose , fatigue ,stress** , etc are extracted from user to take the decision.
- If any a**nomaly is found the user can directly admitted to nearby clinic /hospital.**

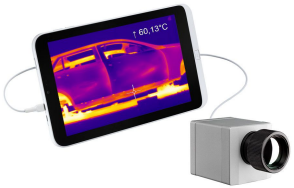
HIGH FEVER NO MASK

WHO WILL BE BENEFITING FROM SOLUTION?

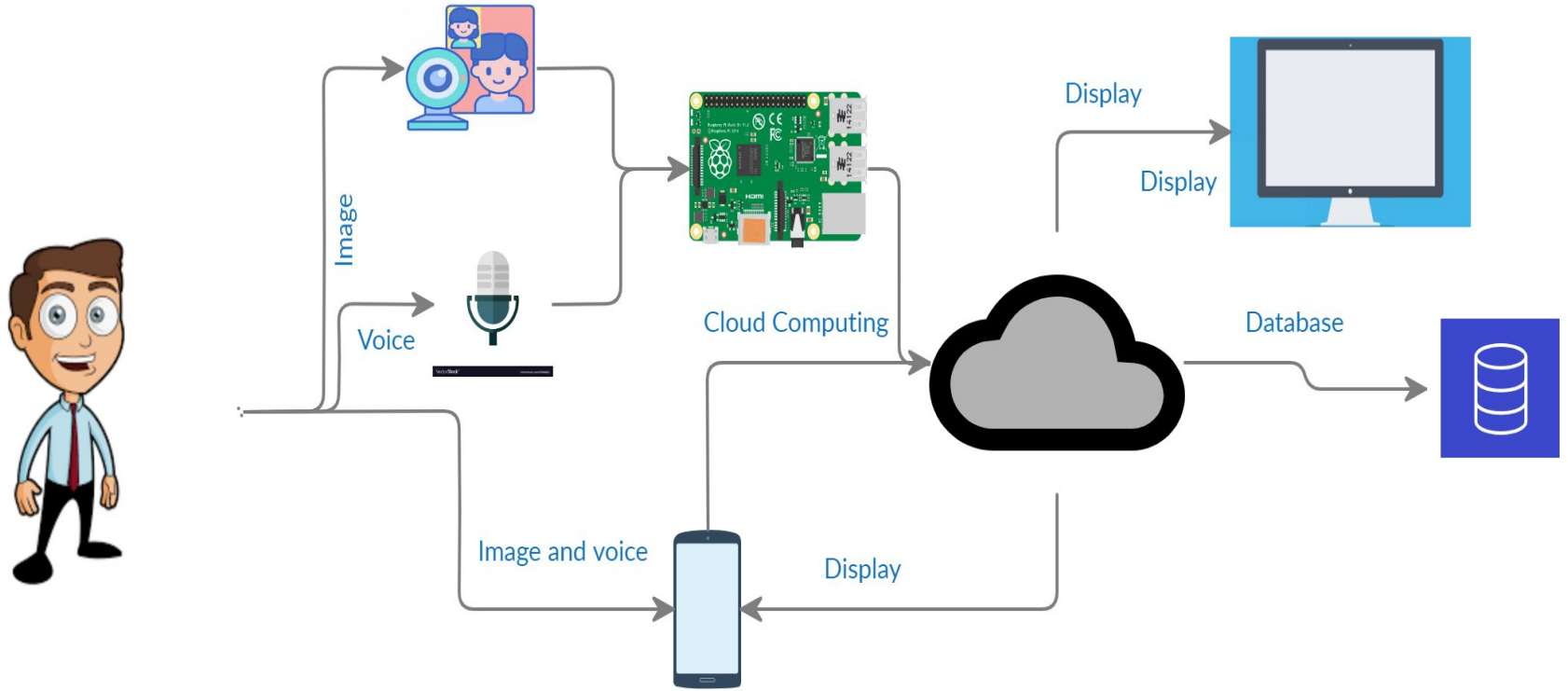
- Public places like Auditoriums , Theatre, Parks Markets, Railway Station , Airports etc.
- Corporate workplaces and co-working environment.
- Society , Residential complexes
- Government organizations and process like voting and parliament sessions
- Entertainment , Automobile and other industries where procedures cannot be done remotely.

MAIN HARDWARE USED

HARDWARE	Purpose of using
RASPBERRY PI	Main device to integrate sensor,camera and connect the system to internet
GPS MODULE	Know the current location of the system
CAMERA MODULE	For mask detection as well as age and gender detection
THERMAL IMAGING CAMERA	For stress and fever detection
MIC	For audio assessment
DISPLAY SCREEN	To display the health report



IOT PLATFORM ARCHITECTURE



IOT ARCHITECTURE

- At public places the image and voice input are taken from the cameras and mic module and the data is sent to raspberry pi.
- The images and audio signals with the present gps coordinates are sent by raspberry pi to the cloud for computing.
- for personal health checking a mobile application is built integrating gps, camera and mic sensors of the mobile and the data obtained is sent to cloud for computing.
- The results for various health detection modules are computed in the cloud and the final output of is sent back to raspberry pi to display it in the screen.
- If the results show that the person is ill the output is also sent to the nearby clinic considering the gps coordinates obtained and google map api.
- Also the results of the person are stored in the database.
- An user friendly application is maintained to keep a track of the various results of the health monitoring done

SAFETY DETECTION ENGINE

- Takes various input parameters to predict the person’s general health condition as normal , mild , moderate and severe.
- The fever module returns true for high body temperature or else false.
- The audio assessment module returns for true for detection of sounds like coughing , runny nose, sneezing , sore throat,nasal congestion or shortness of breath.
- Based on these classifications a decision is made whether the person is fit to enter or not.
- Mask detection is used in order to maintain security of people’s health.

SAFETY DETECTION ENGINE

Non Invasive Safety Detection Engine

The following values are obtained from:

- **Fever:** These values is obtained using thermal camera sensor.If the value is greater than 100 F then 1 else normal body temperature is indicated as 0 (Values field can take 0 and 1)
- **Tiredness:** These values is obtained using the CNN model which takes input from the camera sensor for users face and detects if he/she is drowsy or has signs of fatigue (Values field can take 0 and 1)
- **Dry-Cough:** These values is obtained using Audio Classifier Module (CNN model) which takes audio from audio sensors and detects if person is coughing or not. (Values field can take 0 and 1)
- **Difficulty-inBreathing:** These values is obtained using Audio Classifier Module (CNN model) which takes audio from audio sensors and detects if person has difficultity in breathing or not.(Values field can take 0 and 1)
- **Sore-Throat:** These values is obtained using Audio Classifier Module (CNN model) which takes audio from audio sensors and detects if person has sore throat or not.(Values field can take 0 and 1)

Input values:

Mask:

Fever:

Tiredness:

Dry-Cough:

Difficulty-inBreathing:

Sore-Throat:

Nasal-Congestion:

Runny-Nose:

Gender_Female:

Gender_Male:

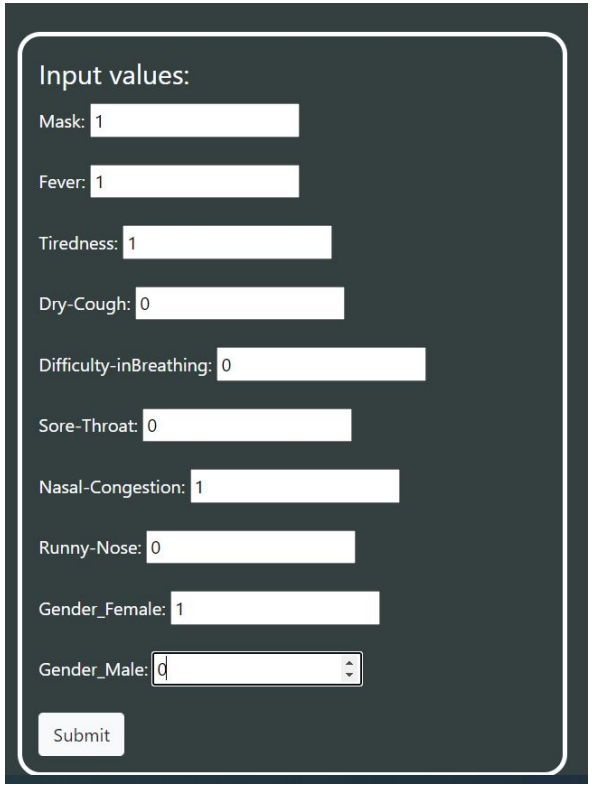
Submit

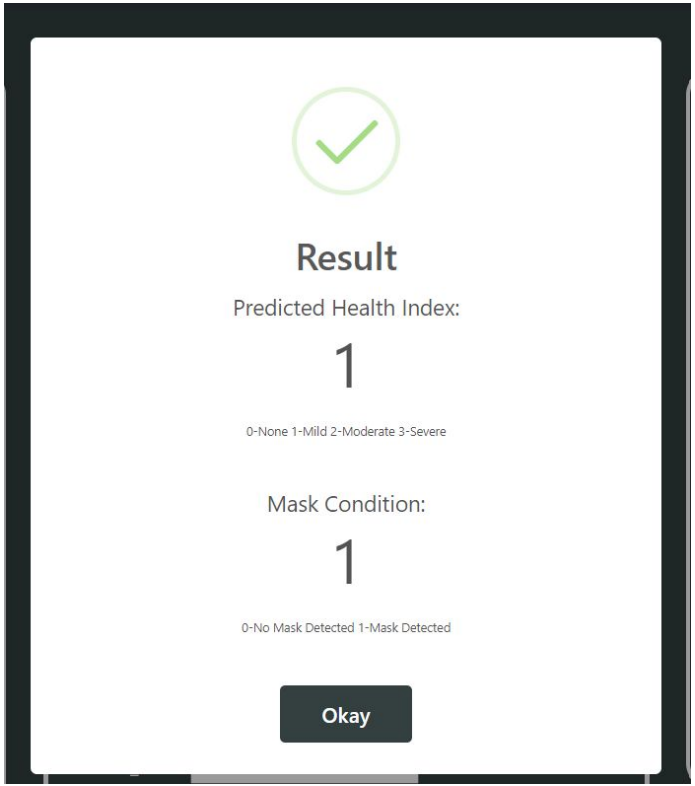
The following values are obtained from:

- **Nasal-Congestion:** These values is obatined using Audio Classifier Module (CNN model) which takes audio from audio sensors and detects if person has nasal congestion or not.(Values field can take 0 and 1)
- **Runny-Nose:** These values is obatined using Audio Classifier Module (CNN model) which takes audio from audio sensors and detects if person has runny nose or not.(Values field can take 0 and 1)
- **Gender-Female and Gender-Male:** These value is obtained using CNN model which takes face image as input and detects whether person is male or female based on features.(Values field can take 0 and 1)(Note: Please make sure either of them is true)
- **Mask-Detected:** These value is obtained from CNN model which takes cropped face image as input and detects whether there is protection or not.(Values field can take 0 and 1)

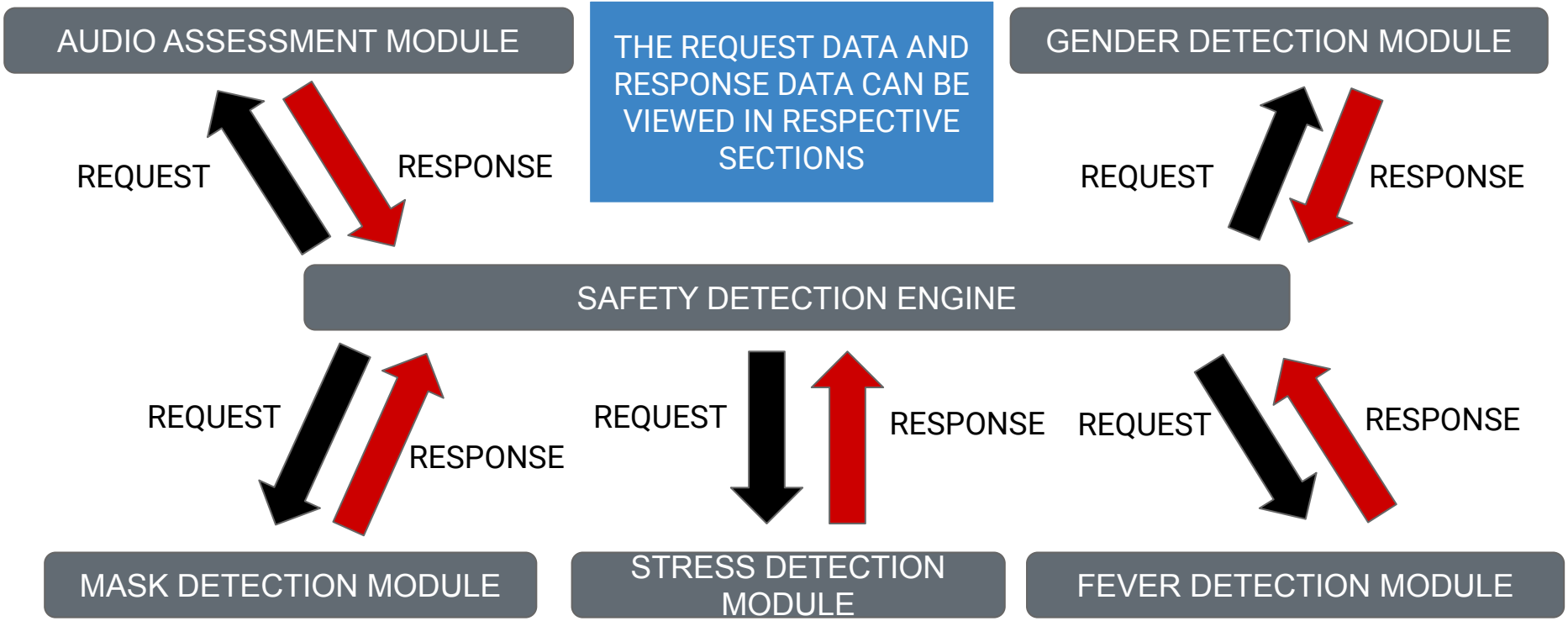
Activate Windows
Go to Settings to activate Windows.

SAFETY DETECTION ENGINE





BACKEND WORKFLOW



FEVER DETECTION MODULE

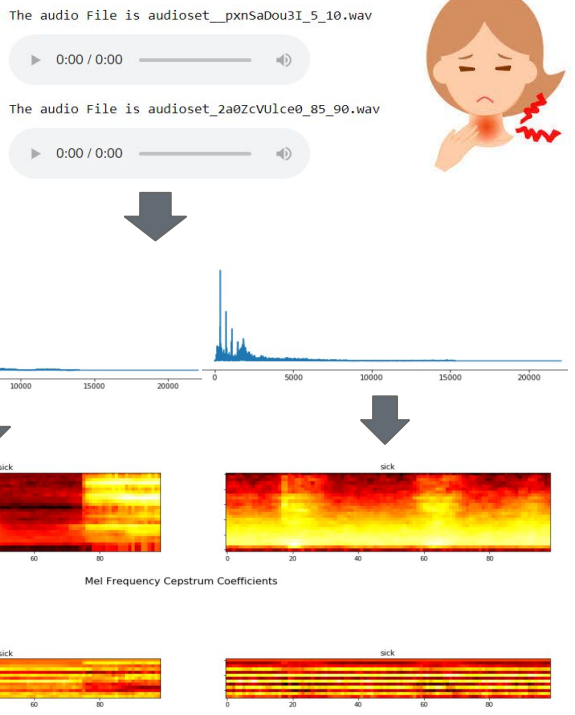
- This module detects fever by using thermal camera that give accurate results and is cost effective.
- To get the most accurate readings the system relies on sampling the temperature of the eye canthus. the eye canthus is the corner of the eye,closest to the nose bridge and is considered the best facial location to measure core body temperature.
- Detecting the facial features , including the eye canthus, using an optical image and transport the coordinates to the corresponding ir image and measure the temperature, this is attractive due to already available robust open-source facial feature algorithms in the market.

AUDIO ASSESSMENT MODULE

- Sounds like cough and sneezing are protective reflex conveying information on the state of the respiratory system.
- The recorded audio will be encoded as image spectrum using techniques like RASTA-PLP and speech libraries like mfcc.
- Further ml based models classify the input into target labels like:

  - runny nose
  - nasal congestion
  - sore throat
  - coughing
  - sneezing
  - shortness of breath

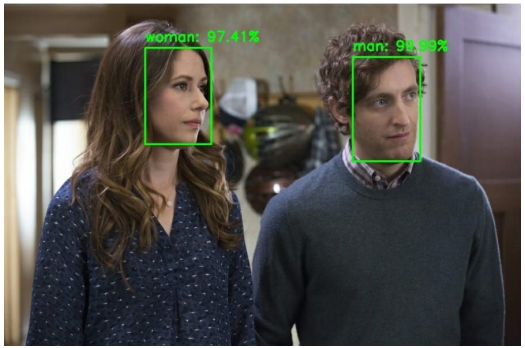
- Given is model predicting the whether the person is coughing or not provided sample data.



GENDER DETECTION MODULE

- This module is based on gender detection in which a model is created by training smaller vggnet from scratch on around 2200 face images (~1100 for each class).
- Face region is cropped by applying face detection using cvlib on the images. it achieved around 96% training accuracy and ~90% validation accuracy. (20% of the dataset is used for validation).
- Given is model predicting the whether the person is coughing or not provided sample data.
- The following is a result of model detecting gender based on given sample data.

INPUT IMAGE



OUTPUT IMAGE

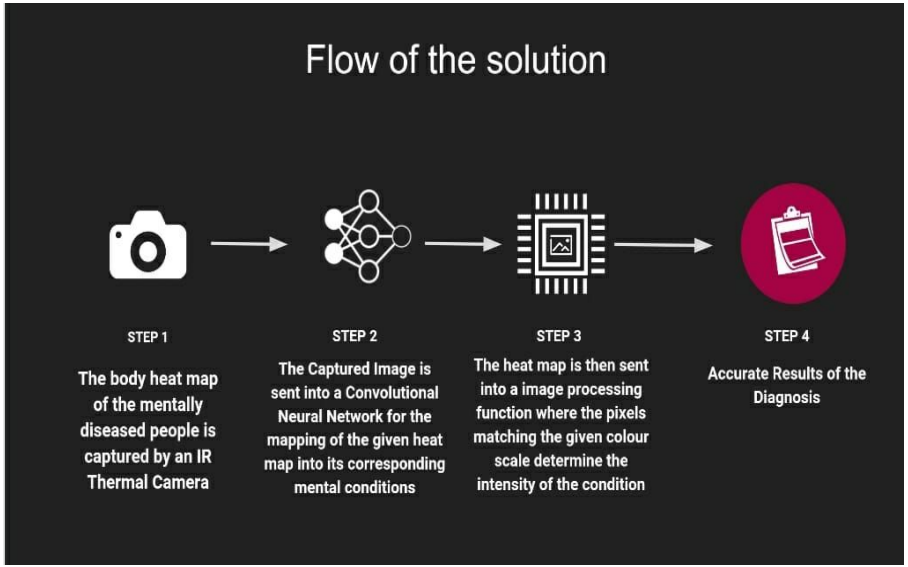
STRESS DETECTION MODULE

- This module detects the facial stress with accuracy by means of generating a body heat map of the patient with the help of a thermal camera
- It applies techniques of image processing and deep learning image classification model to measure the magnitude of the detected stress level.

INPUT IMAGE

OUTPUT:

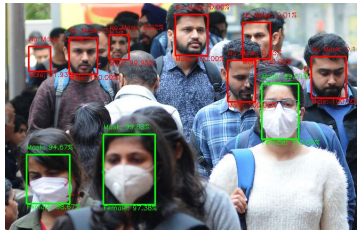
NOT-STRESSED



MASK DETECTION MODULE

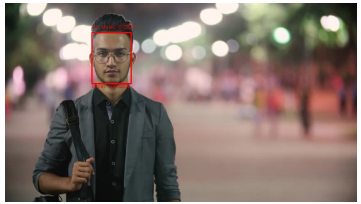
- This module detects the presence of safety measure like mask, ppe kit or face shield. it is a convolutional neural network.
- The complete architecture of the model can be viewed here. the input OF the model is cropped face provided by the face detection engine.
- In the images on the right, green bounding box indicate that mask is worn and vice versa for the red bounding box.

INPUT IMAGE



OUTPUT IMAGE

INPUT IMAGE



OUTPUT IMAGE

PILOT DEPLOYMENT

- Infosys Hyderabad SEZ is largest DC with the land area of more than 430 Acres and more than 25000 employees.
- The device will be integrated at entry sections at auditorium,halls,meeting rooms,classrooms,working cubicles etc.
- It can also be integrated and specifically programed for automated doors in campus
- Also custom device attendance and work space efficiency can also be done.

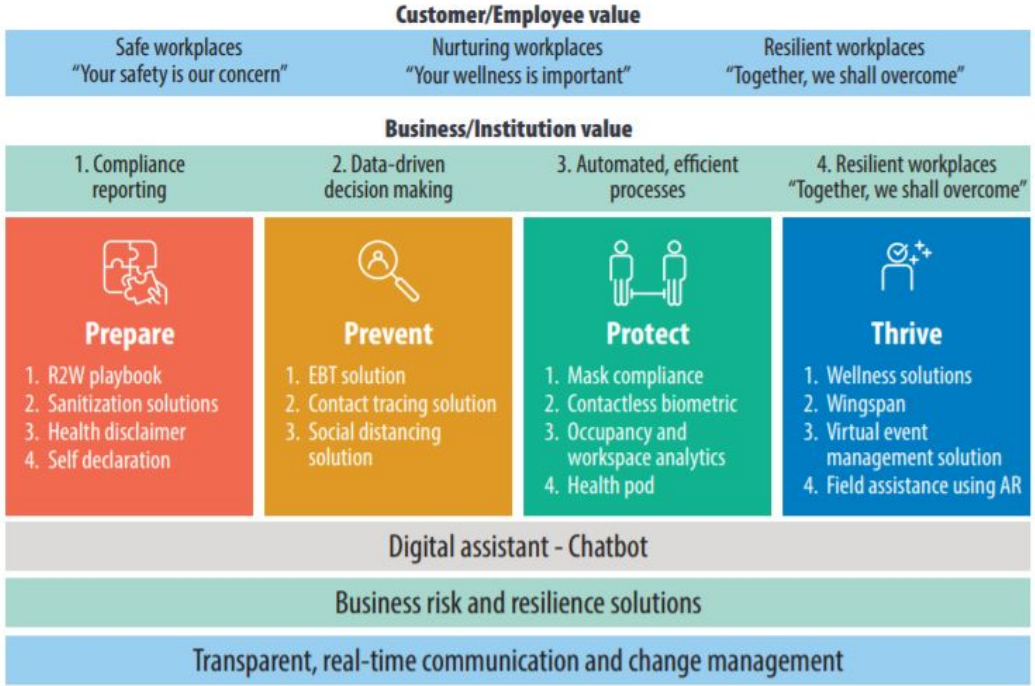
FoodCourt

Campus

Indoor Spaces

Classroom

INFOSYS CAPABILITIES & GAPS



Infosys Return to Workplace Solutions (Current Capability)

GAPS

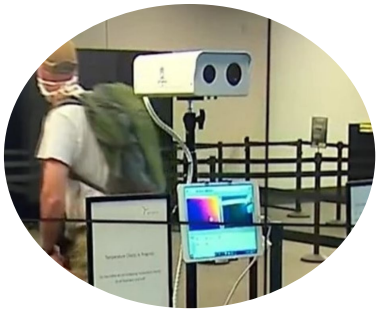
The current solution described in the Infosys Return to Workplace, emphasises on Elevated Body Temperature as major evaluation for fitness. However, body temperature depends upon various parameters like stress level, ambient temperature, gender, making it as sole parameter is not appropriate. We propose that using our algorithm would fill the gaps by incorporating parameters like stress level detection, audio detection which are feeded to main engine that determines the fitness of the individual. Engine is trained on large dataset of health diagnostic making it much more reliable. This improvisation would help Infosys in creating much safer environment for their clients.

MARKET COMPETITION ANALYSIS

- Currently Devices like **Athena Security, Servers check's Elevated Skin Temperature (EST)** can be used in small Workspaces for Temperature Screening.
- **ProGlove** helps workers maintain proper distance from each other and warns them when they are in proximity with other workers.
- Deep-tech startup BlueSemi has developed an IoT-based contactless, wireless thermal scanning device called **Neem**, which accurately measures an individual's body temperature and can be integrated into corporates' security software.

Neem

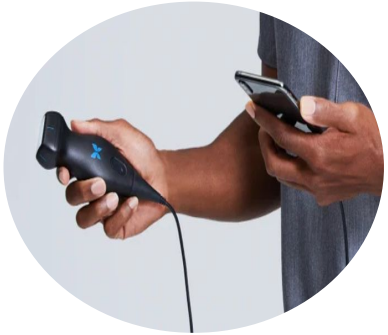
ProGlove



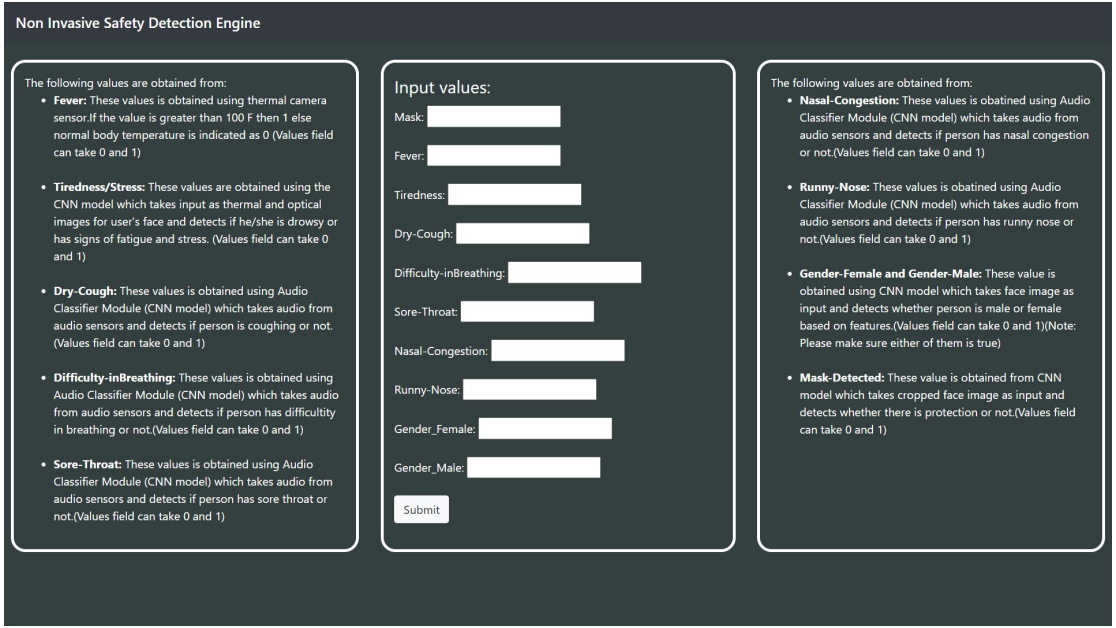
EST

FURTHER SCOPE

- To increase Workplaces efficiency a dedicated Attendance and Surveillance System can be further developed.
- Indoor Diagnostic System for personal and small-scale use.
- Hospitals and Clinics can have smart diagnostic system by integrating our device with more useful sensors like POCUS (ultrasound) to check functionality of lungs and chest .
- Deployment at Public Transport Vehicles like ola , uber and other Places can be made for safer transits with more powerful surveillance system .
- People living in rural areas can access doctors remotely with the help of diagnostic system.



DEMO



The demo of safety detection engine using simulated values can be viewed at :
safety-detection-engine.herokuapp.com/

THANK YOU!