

# Bank of Baroda Hackathon - 2022

## Team SUDO

SUDO is a technical project group created by the pre-final year Students of Dr BC Roy Engineering college for contributing in open source projects.

Date : 18th September, 2022



**Problem Statement:** *Understanding the customer sentiments, patterns, behaviours and actions for proactive Surveillance through video analytics, for providing better services to customers in certain branches of banks .*

Many banks nowadays have installed security cameras that are monitored by AI. But still there are many loose end where any bank's security is compromised. With the current surveillance system it's hard to:

1. Track suspicious activity
2. Tracking any object belonging to a person
3. Analysing Facial expression for better suspicion prediction

With our enhanced AI Surveillance System, we will get accurate results and more precise decisions can be made. With our system we can:

1. Easily detect any suspicion, having 3 tier checking, i.e. sentimental analysis, behavioral analysis and tracking any belonging object of a person.
2. Tracking a person throughout its existence in the surveillance area.
3. Identifying Employee/ Authorised person for allowing access to confidential areas.
4. Spatial Analysis for analysing intrusion in high priority areas.

And finally, our new and enhanced alert system which secretly alerts the guards in case of emergency so as to seize the culprit without letting anyone know, hence catching the culprit red-handed.

# User Segment & Pain Points

Our solution is dynamic surveillance system. It can be used at multiple organisations but is most suited for banks. Though there are numerous bank surveillance systems existing out there. Some key features that our solution will be providing are listed below:

1. **Combating operator fatigue:** A well-motivated security guard to concentrate on a monitor screen drops by 90%. AI based mechanism observation not only eliminates human error but also requires a low ratio of monitors to cameras with attention being focused on known "hotspots" and previously identified issues.
2. **Body language and pattern of movement in video analysis:** Continuously analysing a regular person's movement with the contrasting behaviour of a criminal hovering near a succession of vehicles and assessing them before attempting a break-in.
3. **Continuous analysing time taken for activity on premises:** Tracking every person entering the surveillance area and continuously running check for any suspicious activity or for activities that are taking longer time by any person.
4. **Identification of known facilitators:** Checking from the database for facial recognition of working members and officials for identification and authorization in accessing high priority areas.
5. **Alert Mechanism:** In case of any emergency or suspicious activity detection, an alert will be generated to notify the guards only to ensure confidentiality. Ultimately, confiscation the culprit.

# Prerequisite

At present some cameras are having IVS(Intelligent Video Surveillance) technology, which adds a level of intelligence to the camera outside just motion detection. Those cameras having this feature comprises of the following functionality:

- **Tripwire:** It allows the user to define a line of field of view. If the line is crossed, an alarm will be triggered.
- **Face Detection :** Detects face with in the image and send them to NVR for analysis.
- **Intrusion Detection :** Detects objects entering or leaving the area.
- **Abandoned/Missing :** Detects whether an object is missing from a defined area for a particular time.
- **Scene change :** Detects whether the camera has been moved from the area it was installed. If yes then an alarm is triggered.

# Azure tools or resources

Azure tools will largely help us in building a secure, robust and reliable surveillance system. Below mentioned are the Azure services we will be using in our project:

1. Azure IoT hub
2. Azure IoT edge
3. Azure cognitive services - Spatial analysis container
4. Azure stream analytics
5. Azure cosmos db

Below mentioned are the development tools that we will be using in this project:

1. Azure CLI
2. VS code

# Our Solution: AI Surveillance System

Our AI Surveillance System is a complete secured security solution. It will be covering all the flaws that the earlier systems failed to tackle. Primarily we are introducing an AI based models that continuously monitors the video feed coming from the dome camera installed in the premises. We have divided the whole system in a few parts:

**Phase 1-** Capturing and identifying every entity that is entering into the premises of our surveillance area.

**Phase 2-** If the identified entity is a person, the a tracking system will get triggered and that person will be tracked throughout the entire time it remains in our surveillance area. And if the identified entity is an object then it is to be verified by the guards.

**Phase 3-** While keeping track of that person we continuously analyse the person's behavior, his movements and his facial expressions and if any of those are found suspicious then our alert system will be triggered.

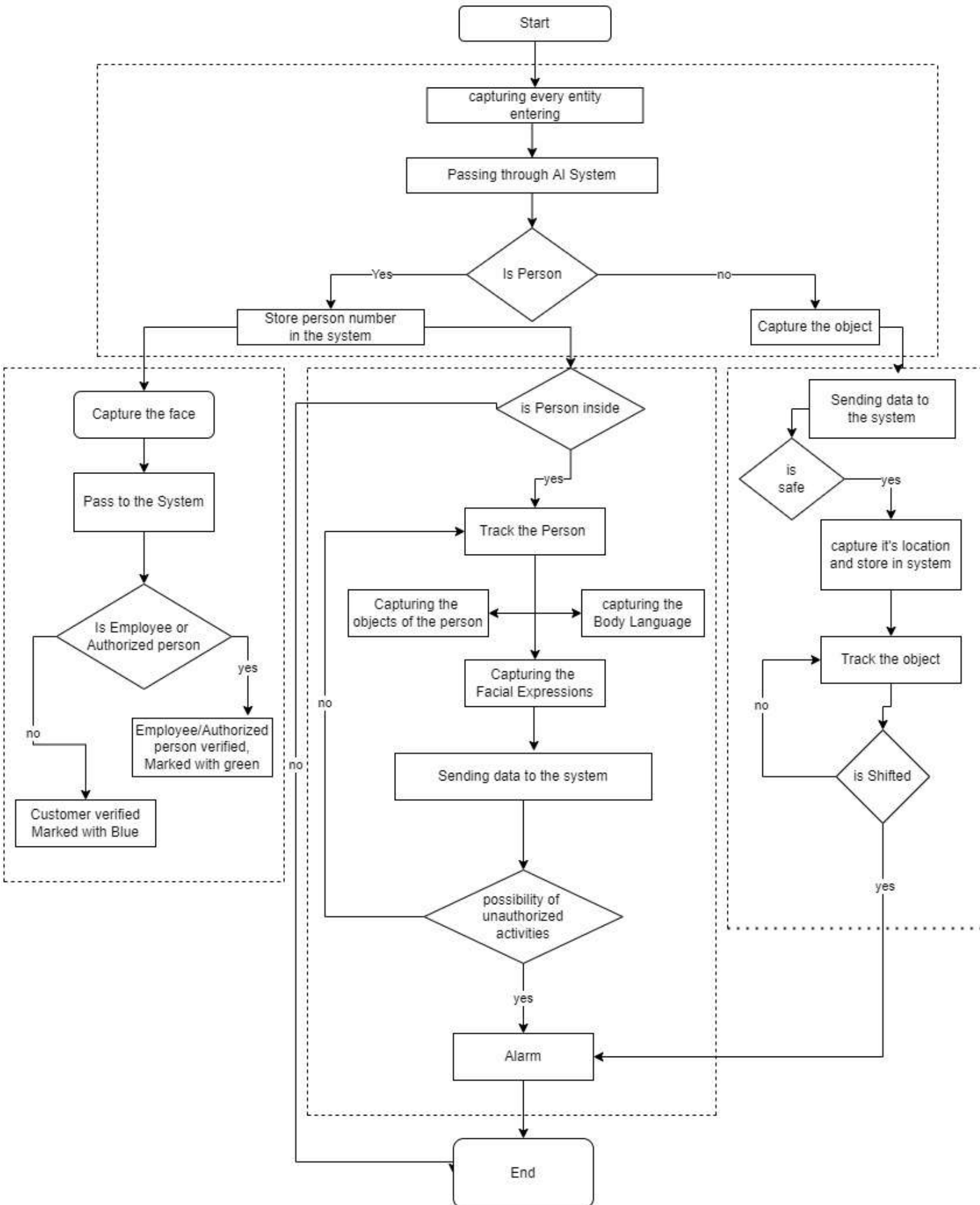
**Phase 4-** New and enhanced alert system, when triggered it will send an alert to all the guards present at the perimeter(system), so as to take the necessary action. We decided to implement this system in order to maintain the confidentiality of the process. As with the normal alert system consisting of a buzzer, the culprit too gets alerted about his mis move and takes precautions. Hence we are using this method.

# Detailed Description of our project

AI Surveillance System is going to be a complete surveillance model that takes video feed coming from the dome camera as input and then run multiple (models or algorithm) to take different decisions based on different test cases as result of the continuous analysis. We have mentioned the features that we will be providing:

1. Entity Detection - Person or Object
2. Object Identification
3. Person tracking
4. Facial Recognition (Employee/ Authorised person Identification)
5. Behavioural Analysis
6. Sentimental Analysis
7. Belonging Object Identification
8. Object Tracking
9. Intuitive and improved alert system

# Overview of our AI Surveillance System



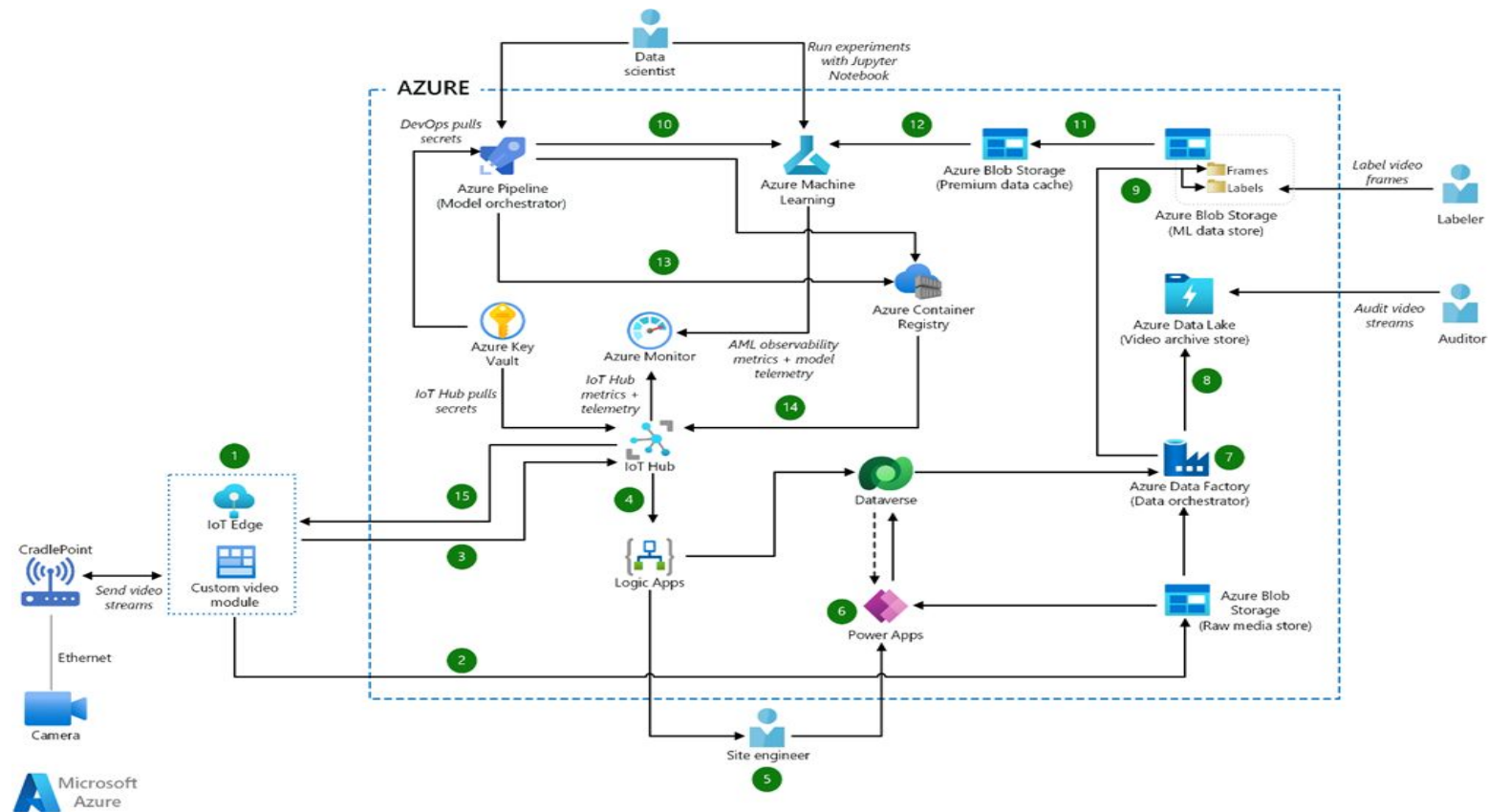


# Detailed Description of our project

As per the above mentioned features our AI model will be testing the input video against the following parameters in order to take different decision. They are as follow:

1. Entity Detection
2. Object Safety Detection
3. Employee Identification
4. Continuous Analysis against
  - a. Suspicious Behaviour Detection
  - b. Sentiment Analysis
  - c. Belonging Object Tracking
5. Object Tracking(not related to customer, i.e. object already present in premises)

# Diagram of the systems with tools used in our project



# Dataflow of the above diagram

1. The IoT Edge custom module captures the live video stream, breaks it down into frames, and performs inference on the image data to determine if an incident has occurred.
2. The custom module also uses Azure storage SDK methods or blob API to upload the raw video files to Azure Storage, which acts as a raw media store.
3. The custom module sends the inferencing results and metadata to Azure IoT Hub, which acts as a central message hub for communications in both directions.
4. Azure Logic Apps monitors IoT Hub for messages about incident events. Logic Apps routes inferencing results and metadata to Microsoft Dataverse for storage.
5. When an incident occurs, Logic Apps sends SMS and e-mail notifications to the site engineer. The site engineer uses a mobile app based on Power Apps to acknowledge and resolve the incident.
6. Power Apps pulls inferencing results and metadata from Dataverse and raw video files from Blob Storage to display relevant information about the incident. Power Apps updates Dataverse with the incident resolution that the site engineer provided. This step acts as human-in-the-loop validation for model retraining purposes.
7. Azure Data Factory is the data orchestrator that fetches raw video files from the raw media store, and gets the corresponding inferencing results and metadata from Dataverse.

## Dataflow of the above diagram

8. Data Factory stores the raw video files, plus the metadata, in Azure Data Lake, which serves as a video archive for auditing purposes.
9. Data Factory breaks raw video files into frames, converts the inferencing results into labels, and uploads the data into Blob Storage, which acts as the ML data store.
10. Changes to the model code automatically trigger the Azure Pipelines model orchestrator pipeline, which operators can also trigger manually. Code changes also start the ML model training and validation process in Azure Machine Learning.
11. Azure Machine Learning starts training the model by validating the data from the ML data store and copying the required datasets to Azure Premium Blob Storage. This performance tier provides a data cache for faster model training.
12. Azure Machine Learning uses the dataset in the Premium data cache to train the model, validate the trained model's performance, score it against the newly trained model, and register the model into the Azure Machine Learning registry.
13. The Azure Pipelines model orchestrator reviews the performance of the newly trained ML model and determines if it's better than previous models. If the new model performs better, the pipeline downloads the model from Azure Machine Learning and builds a new version of the ML inferencing module to publish in Azure Container Registry.
14. When a new ML inferencing module is ready, Azure Pipelines deploys the module container from Container Registry to the IoT Edge module in IoT Hub.
15. IoT Hub updates the IoT Edge device with the new ML inferencing module.

# Components used in the above diagram

- · Azure IoT Edge service analyzes device data locally to send less data to the cloud, react to events quickly, and operate in low-connectivity conditions. An IoT Edge ML module can extract actionable insights from streaming video data.
- · Azure IoT Hub is a managed service that enables reliable and secure bidirectional communications between millions of IoT devices and a cloud-based back end. IoT Hub provides per-device authentication, message routing, integration with other Azure services, and management features to control and configure IoT devices.
- · Azure Logic Apps is a serverless cloud service for creating and running automated workflows that integrate apps, data, services, and systems. Developers can use a visual designer to schedule and orchestrate common task workflows. Logic Apps has connectors for many popular cloud services, on-premises products, and other software as a service (SaaS) applications. In this solution, Logic Apps runs the automated notification workflow that sends SMS and email alerts to site engineers.
- · Power Apps is a data platform and a suite of apps, services, and connectors. It serves as a rapid application development environment. The underlying data platform is Microsoft Dataverse.
- · Dataverse is a cloud-based storage platform for Power Apps. Dataverse supports human-in-the-loop notifications and stores metadata associated with the MLOps data pipeline.
- · Azure Blob Storage is scalable and secure object storage for unstructured data. You can use it for archives, data lakes, high-performance computing, machine learning, and cloud-native workloads. In this solution, Blob storage provides a local data store for the ML data store and a Premium data cache for training the ML model. The premium tier of Blob Storage is for workloads that require fast response times and high transaction rates, like the human-in-the-loop video labeling in this example.

# Components used in the above diagram

- · Data Lake Storage is a massively scalable and secure storage service for high-performance analytics workloads. The data typically comes from multiple heterogeneous sources and can be structured, semi-structured, or unstructured. Azure Data Lake Storage Gen2 combines Azure Data Lake Storage Gen1 capabilities with Blob Storage, and provides file system semantics, file-level security, and scale. It also offers the tiered storage, high availability, and disaster recovery capabilities of Blob Storage. In this solution, Data Lake Storage provides the archival video store for the raw video files and metadata.
- · Azure Data Factory is a hybrid, fully managed, serverless solution for data integration and transformation workflows. It provides a code-free UI and an easy-to-use monitoring panel. Azure Data Factory uses pipelines for data movement. Mapping data flows perform various transformation tasks such as extract, transform, and load (ETL) and extract, load, and transform (ELT). In this example, Data Factory orchestrates the data in an ETL pipeline to the inferencing data, which it stores for retraining purposes.
- · Azure Machine Learning is an enterprise-grade machine learning service for building and deploying models quickly. It provides users at all skill levels with a low-code designer, automated machine learning, and a hosted Jupyter notebook environment that supports various IDEs.
- · Azure Pipelines, part of Azure DevOps team-based developer services, creates continuous integration (CI) and continuous deployment (CD) pipelines. In this example, the Azure Pipelines model orchestrator validates ML code, triggers serverless task pipelines, compares ML models, and builds the inferencing container.
- · Container Registry creates and manages the Docker registry to build, store, and manage Docker container images, including containerized ML models.
- · Azure Monitor collects telemetry from Azure resources, so teams can proactively identify problems and maximize performance and reliability

# How is your solution better than alternatives?

1. Speed- Low time delay as compared to other existing solutions
2. Accuracy- giving accurate(true positive) result
3. Precision- repeating the same accuracy without fail
4. Scalability- can also work with large scale of data without flaw
5. Useability- easy to use by consumers

## How do you plan to build adoption plan?

Our solution is easy to use and implement the banks

# GitHub Repository Link

[https://github.com/dollykumari9798/AI\\_Surveillance\\_System](https://github.com/dollykumari9798/AI_Surveillance_System)

## How far it can go?

With the current analysis of our proposed solution it is going to be a full fledged system that can be implemented into banks. With the azure services we will be using the time delay for our entire system will also be minimum. With multiple parameters for checking, it's far more secure than what we have as our existing surveillance solutions. With a bit of trial and testing our solution can be one of the most finest AI based surveillance solutions out there that could help out not only in banks but also in different areas where AI can be of big help in security surveillance.



**TECHGIG**

**Thank You**

Dolly Kumari

Priyanshu Halдар

Ankan Mandal

Nidhi Shreya