Live Service Monitoring

Project Proposal

XLoop Digital Services

1. Introduction

We are excited to present a revolutionary proposal that redefines the landscape of live service monitoring in the banking sector. In a digital age where customer experience and operational efficiency are paramount, we are here to develop an innovative solution that harnesses the power of AI and computer vision to elevate your bank's service quality to unprecedented heights.

Our proposal addresses key challenges faced by the banking industry, ranging from maintaining premises' cleanliness to optimizing customer queues and ensuring ATM functionality. Leveraging cutting-edge technology and domain expertise, we introduce a comprehensive AI-driven live service monitoring system that not only fulfills standard operational requirements but also introduces forward-thinking features that align with international standards and customer-centric practices.

2. Targeted Problems:

Problem 1: Object Detection:

The objective is to develop an object detection model to assess different use cases, as follows.

1. Parking Area Upkeep and Management:

Approach: Utilize object detection models, such as Faster R-CNN or YOLO, to identify issues related to cleanliness and assess parking space availability.

Data Annotation: Define the boundaries of the parking area and annotate individual parking spaces. For cleanliness, mark specific regions of interest (ROIs) where cleanliness levels need assessment.

Data Preprocessing: Extract frames from CCTV footage, ensuring the model can make correct decisions. Simulate variations in lighting, weather conditions, and parking space occupancy (occupied or vacant) to enhance model robustness.

Assumptions: Assume consistent camera angles and lighting conditions, as well as clear and standardized parking space markings.

2. Cleanliness/Upkeep of Inside Branch and ATM:

Approach: Deploy object detection or semantic segmentation models to identify areas within the branch or ATM that require assessment.

Data Annotation: Annotate the boundaries or outlines of areas of interest (e.g., reception area, seating sections, counters). Additionally, label these areas with cleanliness/upkeep levels, which can be defined using a scale or categories.

Data Preprocessing: Extract frames from CCTV footage, standardize image sizes, and apply data augmentation techniques to simulate various lighting conditions.

Assumptions: Assume consistent camera placement and lighting conditions within the branch or ATM.

3. No Posters or Outdated Marketing Material Posted:

Approach:

Utilize Optical Character Recognition (OCR) technology to scan and analyze text content on posters and marketing materials.

Extract text content from posters and materials present in the monitored areas.

Data Annotation: Annotate the typical locations where posters are displayed and categorize them as either "up to date" or "outdated."

Data Preprocessing: Extract frames from CCTV footage, standardize image sizes, and consider data augmentation to simulate different poster conditions.

Assumptions: Assume high-quality CCTV cameras are installed on the premises, ensuring that posters and marketing materials are clearly visible in the footage. Also, assuming that the text content on posters and marketing materials is eligible for accurate OCR processing.

4. Availability of Printed Product Brochures/Branding:(Research still pending)

Approach: Object detection models to locate and monitor the presence of brochures and branding materials.

Data Annotation: Annotate the designated areas where brochures and branding materials should be available and label them as "available" or "missing."

Data Preprocessing: Extract frames from CCTV footage, standardize image sizes, and consider data augmentation to account for variations in lighting conditions.

Assumptions: Assume consistent placement areas for brochures and branding materials.

5. Espresso Counter Is Tidy:

Approach: Use either image classification or object detection models to assess the tidiness of the espresso counter.

Data Annotation: Annotate the espresso counter area and classify it as either "tidy" or "not tidy."

Data Preprocessing: Extract frames from CCTV footage, standardize image sizes, and consider data augmentation to address potential variations in lighting conditions.

Assumptions: Assume a consistent layout for the espresso counter and stable lighting conditions.

Problem 2: Detecting Human Actions:

1. Customer Scanning upon entry

Detecting customer scanning upon branch entry using video analysis for improved security and privacy.

Approach: To address the problem of detecting inappropriate customer scanning by security guards using LSTM-based CCTV monitoring, we propose the following solution:

> **LSTM-Based Sequence Classification**: Design an LSTM-based deep learning model to analyze sequences of video frames. LSTM is suitable for capturing temporal patterns in sequences, making it ideal for this problem.
>
> > **Input**: Sequence of video frames representing the interaction between the security guard and the customer.
> >
> > **Output**: Binary classification indicating whether the interaction includes scanning (1) or not (0).

Assumptions: To address this problem, the following types of data are required:

> **Video Data**: CCTV camera footage from outside the bank capturing interactions between security guards and customers. This footage will serve as the primary input for the LSTM model.
>
> **Time Stamps**: Accurate timestamps for each video frame are essential for identifying the duration of interactions and the sequences of actions.

2. Analyzing ATM Functionality:

Analyzing ATM functionality using video data to determine whether customers successfully withdraw cash, ensuring proper ATM operation.

Approach:

> **Cash Detection and LSTM Model:** Use computer vision techniques to develop a cash detection model capable of identifying whether a customer has cash in hand. Design an LSTM-based model to analyze sequences of frames from the CCTV footage.
>
> > **Input**: Sequence of video frames capturing customer interactions at the ATM.
> >
> > **Output**: Binary classification indicating whether ATM functionality is likely (1) or unlikely (0) based on cash detection.

Assumptions: To address this problem, the following type of data is required:

> **Video Data**: CCTV camera footage capturing customers' interactions with the ATM. The video data should clearly show customers approaching the ATM, their actions, and whether they have cash in hand.

Challenges: Detecting ATM functionality solely based on whether customers have cash in hand through CCTV footage can be a challenging and less reliable approach. While it's an interesting idea, there are several factors and limitations to consider:

> **Visibility and Clarity**: Detecting cash in hand accurately from CCTV footage can be challenging due to factors such as lighting conditions, camera angles, customer clothing, and occlusions. The quality and resolution of the camera are crucial for accurate detection.
>
> **False Positives and Negatives**: Cash detection algorithms might produce false positives (detecting cash when it's not present) or false negatives (failing to detect cash when it's present). These errors could lead to incorrect conclusions about ATM functionality.
>
> **Variability in Customer Behavior**: Not all customers withdrawing money from an ATM will necessarily have cash in hand. Some customers might deposit cash or perform other transactions without cash in hand, leading to false determinations about ATM functionality.
>
> **Context and Intent**: Detecting cash in hand doesn't necessarily guarantee ATM functionality. Customers might have cash for other purposes, and not all customers withdrawing money will do so successfully.

3. Identifying Customer Greeting:

Identifying customer greetings during branch entry through video analysis to enhance customer service and engagement.

Approach: To address the problem of detecting customer greetings using LSTM-based employee interaction analysis, we propose the following solution:

> **Employee Interaction Analysis and LSTM Model**: Apply computer vision techniques to identify employees and customers in the video frames. Develop an LSTM-based model to analyze sequences of frames from the CCTV footage.
>
> > **Input**: Sequence of video frames capturing customer interactions with employees upon entering the bank.
> >
> > **Output**: Binary classification indicating whether a customer greeting occurs (1) or not (0).

Assumptions: To address this problem, the following type of data is required:

> **Video Data**: CCTV camera footage capturing customers' interactions with employees as they enter the bank. The video data should clearly show customer movements and employee actions.

Problem 3: Visual Recognition

1. Monitoring Security Guard Uniform:

The manual process of monitoring security guard uniform compliance and staff attire is time-consuming as well as error prone.

Approach:

To empower the system to accurately appraise both uniform adherence and staff attire using computer vision and AI, we can use techniques such as image processing and analysis. Here are a few specific techniques that might be considered: Pose Estimation, Real-time Analysis, Machine Learning, and Deep Learning.

Assumptions:

- **Adequate camera coverage:** Assumes that there are sufficient cameras placed strategically throughout the bank premises to provide comprehensive visual data.
- **Camera feed access:** Assumes a continuous stream of camera data that can be processed in real-time.
- **Labeled dataset:** Assumes the availability of a labeled dataset containing images of proper attire and non-attire (e.g., id card wearing, folded sleeves, guard uniform) to train the AI model.

Problem 4: Measuring Light Intensity

1. Detecting Light Conditions

The problem involves the detection of lighting conditions within the bank premises.

Approach: To estimate the intensity of lighting in a room using computer vision and AI, we can use techniques such as image processing and analysis. Here are a few specific techniques that might be considered:

Histogram Analysis: Create histograms of pixel intensity values in the captured images. Well-lit areas will have higher average pixel values, while darker areas will have lower values.

Region-based Analysis: Divide the image into regions and calculate average pixel intensity values for each region. This can help identify areas with varying lighting conditions.

Color-based Analysis: Analyze the color distribution in the image. Well-lit areas might have more vibrant and saturated colors, while darker areas could have muted colors.

Texture Analysis: Use texture analysis techniques to detect variations in lighting. Well-lit areas might have smoother textures, while darker areas might have more pronounced texture patterns.

Machine Learning: Train a machine learning model to predict lighting intensity based on image features. You could use techniques like regression to establish a relationship between image characteristics and actual lighting measurements.

Deep Learning: Utilize deep learning models, such as convolutional neural networks (CNNs), to learn and predict lighting intensity from images. This approach can capture complex relationships in the data.

Calibration: Incorporate a calibration step using reference images taken under controlled lighting conditions to ensure accurate intensity estimation.

Assumptions:

Adequate camera coverage: Assumes that there are sufficient cameras placed strategically throughout the bank premises to provide comprehensive visual data.

Camera feed access: Assumes a continuous stream of camera data that can be processed in real-time to provide timely alerts about lighting changes.

Labeled dataset: For ML and DL, we need a labeled dataset containing images of different lighting conditions (e.g., normal, dim, bright, emergency lighting) with their intensity levels to train the AI model.

Challenges:

It's important to note that these techniques can provide estimates of lighting intensity, they might not be as accurate as specialized light sensors. The accuracy can be influenced by various factors such as camera settings, image quality, reflections, and shadows. Experimentation and fine-tuning are essential to achieve reliable results.

Other Solutions:

Some other solutions we can provide, other than the current checklist, that can enhance the significance of LSM are:

Suspicious Activity detection from CCTV camera in ATM:

Including,

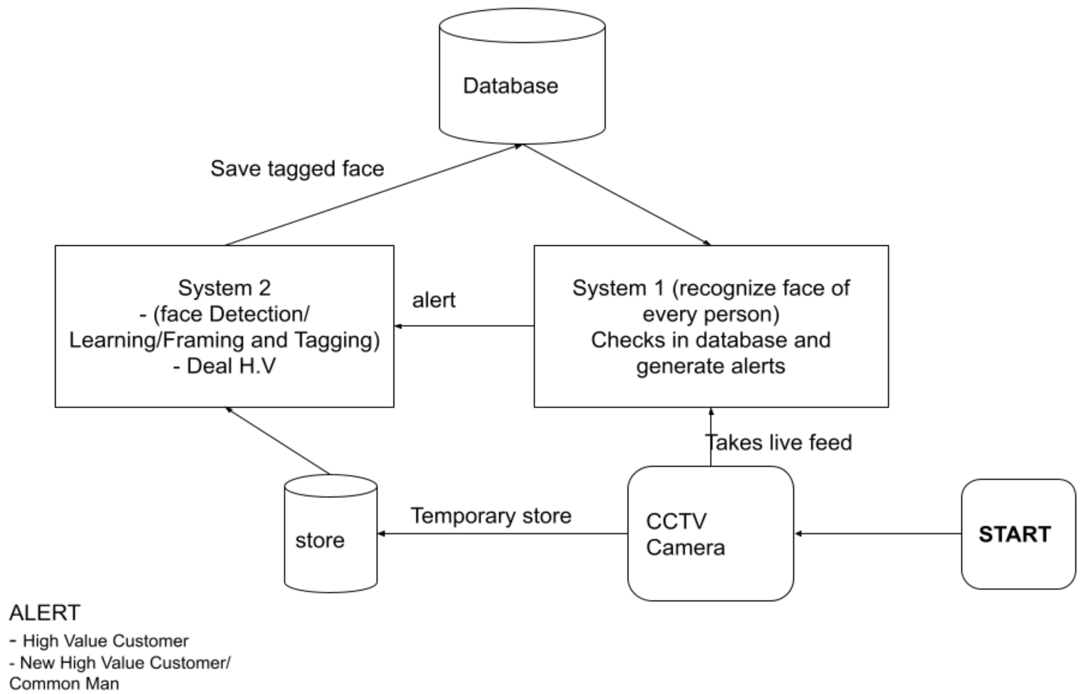
Unusual Movements: Identify movements that deviate from normal ATM usage. For instance, erratic behavior, or unusual gestures could indicate that someone is trying to tamper with the ATM, install skimming devices, or engage in fraudulent activities.

Cash Trapping: Cash trapping involves placing objects in the ATM's cash dispensing mechanism to trap money. Detecting people tampering with the card insertion slot or cash dispenser could help identify potential cash trapping attempts.

Vandalism and Tampering: Detect any signs of tampering or vandalism, such as covering the camera lens, attaching suspicious devices, or damaging the ATM's components.

High Value Customer Identification

The simple flow of detecting high value customers and generating alert:



Customer Waiting Time

Detecting average waiting times in the branch to enhance customer service and satisfaction, while also facilitating suspicious activity detection.

Generate an alert if customer transaction time exceeds threshold.

- Implement a timer mechanism that starts when a customer enters the branch.
- Set a predefined waiting threshold value for the maximum acceptable transaction time.
- If a customer's transaction time exceeds the set threshold, trigger an alert to notify bank staff.
- Record timestamps when customers enter the branch and when their transactions are completed.
- Calculate the time difference between entry and transaction completion to determine each customer's transaction time.

Two basic approaches shall be used here,

Face Detection for customer identification.

Object Detection for people counting.

2. Timeline and Resources

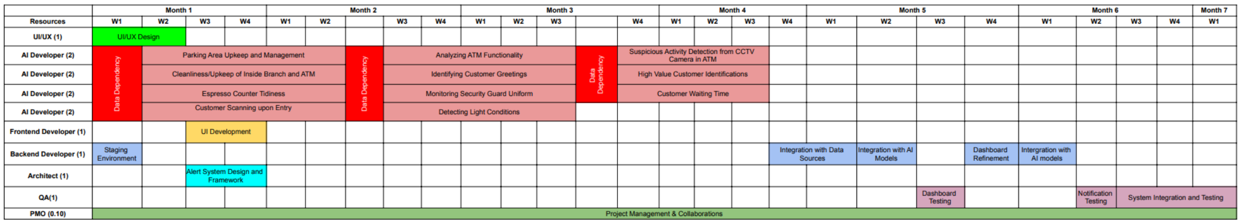
PROJECT START DATE	11st September 2023
PROJECT END DATE	15th March 2024

Deliverable		**Development**
Staging Environment	Creating Stage Environment	16
	Configurations of deployment pipeline	24
Parking Area Upkeep and Management	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Cleanliness/Upkeep of Inside Branch and ATM	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Espresso Counter Tidiness	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Customer Scanning upon Entry	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Analyzing ATM Functionality	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Identifying Customer Greetings	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Monitoring Security Guard Uniform	Data Engineering	40
	Model Development	80
	Testing and Refinement	80

Detecting Light Conditions	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Suspicious Activity Detection from CCTV Camera in ATM	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
High Value Customer Identifications	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Customer Waiting Time	Data Engineering	40
	Model Development	80
	Testing and Refinement	80
Dashboard	Dashboard Design	80
	UI Development	80
	Integration with Data Sources	80
	Integration with AI Models	40
	Dashboard Testing	40
	Refinement	40
Notification System	Alert System Design and Framework	80
	Integration with AI Models	40
	Testing	40
Testing	System Integration and Testing	120
	Pilot Testing	360
Deployment	Deployment and Testing	120
Project Management	15 % of total Hours	158
Total		3518

*All the timelines of AI models depend directly on the availability of Data.

Gantt Chart:



4. Technical Bank Requirements

Cameras and Sensors:

There must be a network of cameras and light sensors strategically placed in certain locations, so they cover the required area.

Network Connectivity:

All the computations will be performed at the main/head office, given the feed has reliable internet connectivity.

Branch specific alerts might need branch networks.

Data Access:

Selected data access would be required, that includes mostly visual and historical data in case of identifying high value customers etc.

Cloud Access:

Cloud services shall be used to manipulate and process.

5. Conclusion

The proposed document offers an efficient and user-friendly solution for Improving and enhancing LSM for banking sector, by leveraging AI and Machine Learning. The problems outlined in this proposal provide a comprehensive overview of the proposed solution.