



IDENTIFICATION OF ABNORMALITIES IN LIVE FEEDS IN THE BANKING INDUSTRY

Project ID 18-116

SRS Report

**Bachelor of Science in Information Technology (Hons) Specializing in Information
Systems Engineering/Software Engineering/Information Technology**

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Uzma Alimudeen	IT 15086426
Kaveesha Savindi	IT 15045836
Tharsika Thurairasa	IT 15106452
Thushan Samarawickrama	IT 14137006

Supervisor: Ms. Shashika Lokuliyana

Co Supervisor: Mr. Anuradha Jayakody

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Engineering/Information Technology

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Declaration

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
Uzma Alimudeen	IT 15086426	
Kaveesha Savindi	IT 15045836	
Tharsika Thurairasa	IT 15106452	
Thushan Samarawickrama	IT 14137006	

The above candidates are carrying out research for their undergraduate Dissertation under my supervision.

Signature of the supervisor:

Date

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1. INTRODUCTION

1.1. Purpose

This document covers all the specifications for the service being created to identify abnormalities in live feeds in the banking industry, focusing on the ATM environment. This is created with the idea of being plugged in to an existing video surveillance system of a bank. The document is meant for the senior management the idea is being proposed to, and the designers and developers of the solution to be able to derive an appropriate plan for implementation.

1.2. Scope

The document covers the feature of all the modules being implemented in the creation of the service - Identification of Abnormalities through live feeds in the banking industry more specifically focused on the ATM environment.

The service looks at identifying abnormalities in the live feed based on human, object, the live feed itself and running the processes in parallel to be efficient and effective.

1.3. Overview

With the new innovations in digital technology and surveillance, the objective is to create a solution for financial institutions such as banks to implement and to tighten security and surveillance within the organization. The solution is to identify and alert staff on any abnormalities visible in the ATM environment, to identify any objects that are prohibited within the ATM, to allow for human identification and analysis, and to ensure the video feed is not being tampered with. The solution also hopes to use available resources as effectively and efficiently as possible with the help of parallel processing that will enable the streamlining of processes.

The solution is to be created so it can be plugged into an existing surveillance system and used, the requirements of new resources, training and other related activities are to be minimized where possible. The solution is to be linked to mobile phones of the security and main over managers that overlook the region and security.

The SRS will contain the features, information, necessary criteria and situations connected to all modules being created for the service.

2. OVERALL DESCRIPTIONS

The purpose of this chapter is to give the reader an overview of the comparison of knowledge in identification of abnormalities in live feeds in the banking industry by using the image processing and parallel processing components of the overall system. In our research we are focusing on the detection of abnormalities within an ATM environment. ATMs can be susceptible to criminal activity if not properly protected. With the increasingly growing need of protection of people and personal properties, video surveillance has become a big concern of everyday life. A consequence of these needs has led to the deployment of cameras almost everywhere. One of the most active areas is activity understanding from video surveillance system. Understanding activities involves being able to detect and classify targets of interest and analyze what they are doing. One crucial aspect is to detect and report situations of special interests, when unexpected things happen. In this case, a video surveillance system which can interpret the scene and automatically recognize abnormal behaviors can play a vital role. The system would then notify operators or users accordingly. The goal is to develop methods and techniques that enable to approach such an ideal surveillance system.

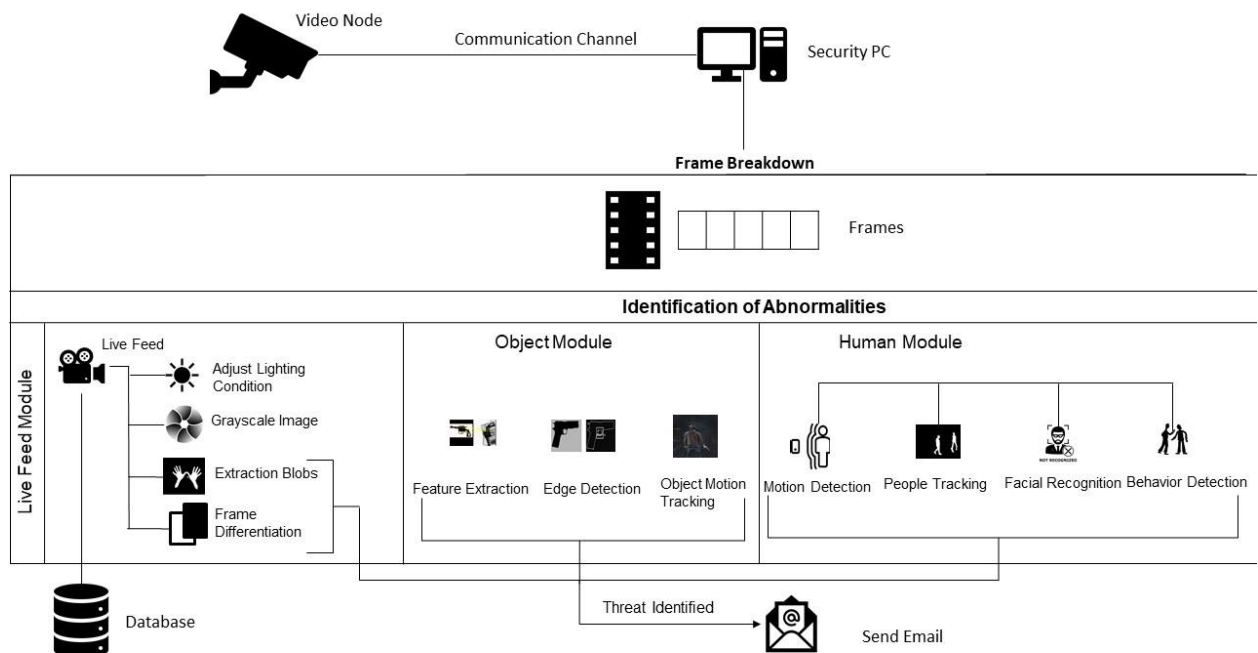


Figure 1 High Level Architecture Diagram

2.1. Product Perspective

With the pace at which crime and fraud rates are going up, it is important for banks to be more proactive in their security measures. After conducting numerous interviews and discussions with a selected group of bank personnel, what our team discovered was that, over the years, there was no proper technology to identifying any abnormalities of behavior, objects or live feed in the bank environment — much less a real-time system to alert the security personnel whenever an unusual activity which threatens the security of the bank is detected. With lessons learnt, the banking industry, however, has been developing and conducting experiments with their current security systems, and as a result, has implemented high end surveillance systems to monitor and detect anomalies that pose as a threat to the bank. In the recent years, there has been an increase in the number of banks worldwide who are making use of the technologies such as, facial recognition, biometrics and motion detection to ensure their security.

2.1.1. System Interfaces

The live feed components using existent video surveillance system to get the video feed and notify by the email application through API. Video surveillance system depends on the surveillance CCTV camera and its quality of the video feed. This live feed component has connected to the other components of the system. We propose to breakdown the video feed into the frame then identify the abnormality in real time using the system feature that we going to use and send the notification via email to one person[1][2].

2.1.2. Hardware interfaces

Following are the basic hardware that are needed for the product,

- PC with a Windows OS installed
- Inbuilt web camera of a PC to simulate the pinhole camera in the ATM
- A Bluetooth camera / or an outside camera connected to the PC to simulate the CCTV camera set up on the ceiling of the ATM kiosk

The user needs to have a PC with Windows OS is installed to install and work with the abnormal human behavior identification process. To use this application, it requires minimum 1 GHz RAM.

2.1.3. Software interfaces

Our research centers on building a system that obtains data from the live feed and performing the anomaly detection algorithms on the said data. And once a threat is detected, it will send an automatic email that contains a warning message to the security personnel. This system is designed and implemented using,

- Microsoft Windows environment
- C# language with OpenCV library
- C# and included libraries for parallel processing needs
- The Smart Surveillance Interest Group Library (SSIGLib) as a support library [3]
- MATLAB - is a numerical computing environment with multiple paradigms. MATLAB allows matrix manipulations, tracing of functions and data, implementation of algorithms with C #.
- EmguCV (OpenCV) - is a cross-platform. Net wrapper to the OpenCV image processing library. Allow OpenCV functions to be called from.Net. Supported languages The OpenCV features will be used to compare the images and differentiate the 2D images from 3D[4].
- Microsoft Visual Studio 2015
- The system is using the windows filesystem as its database component
- Draw.io is a completely free online diagram editor built around Google Drive (TM), which allows you to create the flow diagrams, class diagrams and activity diagrams and process flow diagrams, etc.
- Microsoft PowerPoint is used to design presentation slides and diagrams (i.e. High-level diagram). Also, to be used to create presentation slides that aide the team when presenting the status of the project, progress, etc., to those interested (i.e. Project Supervisor and Lecturer-In-Charge).

2.1.4. Communication Interfaces

The only communication interface would be needed for the email notification to be sent to the employee of an expected abnormality, is an internet connection with a router.

2.1.5. Memory Constraints

For the abnormal human behavior detection process to run smoothly the system requires having a minimum of 4 GB RAM and a minimum storage memory (non-volatile) of 10 GB. One great advantage of this system is, that it can be run on a machine composed of standard PC requirements.

For the parallel processing module which proposes to work with the existing computer(s) available, the application would run mostly as a service, it would be made to work like a background service thus using memory as low as possible. Parallel processing would further reduce the consumption by breaking down the process into manageable threads and i3 processor or higher has been identified as optimal for implementation of this module.

2.2. Product Functions

2.2.1. Abnormalities in Live Feeds

Breakdown the Video feed into frames – We proposed to breakdown the video feed into frames (30 frames per second) due to 30fps is necessary to smoothly record movement and capture the quality images. Frame rate has an impact on the size of the video file. when considering the fast motion, the increasing frame rate may be an option. This method implemented in live feed class which is exposed to a public since it is used by other connected classes. Through this function, other classes can get the current breakdown frames in live feed [5][6][7].

Lighting Condition Method - After breakdown the video feed into frames then checks Lighting Condition of the image and it constantly maintains the fixed contrast ratio using algorithm though under dark light condition. The lighting condition of the ATM would be in a constant to capture the quality image to the video feed [13].

Grayscale - An also we used the Grayscale method to convert the RGB color pixel value to one single color which belongs to the shade of gray [14]. The inherent complexity of grayscale images is lower than from the color images. Compare the grayscale algorithms with the type of images.

Extract Blobs - We proposed a method extract the blobs of the image which is recognize the outline of the moving human and the objective in the video feed and identify anomalies in front of the camera, when image is dark or block the camera lenses by someone or something and it identified as an anomaly then send the Email to one-person kind of images and the algorithms analyses the image looking for in front of the camera objects [15] [3] [16].

Frame Differentiation - We use Frame Differentiation to identify the moving objects. It refers to a very small-time interval of the two images before and after the pixel based on the time difference, and then thresholding to extract the image region of the movement, according to which changes in the region to distinguish background and moving object in the ATM room and if there is no difference between before and after images it must be anomaly. [17] [4] [18] [12] [19].

Notification - When identifying and detecting the abnormalities the automatic Email will be sent to the person who more responsible with the bank security.

2.2.2. Abnormal Human Behavior Identification

To detect abnormalities in the behavior of the users of the ATM, fundamental principles of image processing have been followed. The approach to identifying and tracking abnormal features/behavior in a specific individual will be done as a 4-step process that is run parallel to each other, namely motion detection, people tracking, facial recognition and behavioral detection.

Motion Detection - In this system, in terms of abnormal human behavior identification, motion detection function will be used to identify any kind of suspicious movement inside the ATM. As an example, if an individual is attacking another individual inside the ATM, motion detection function will identify their movements as a threat and will notify the security personnel via a notification email.

People Tracking - Usually, in a secure ATM environment more than one individual should not be present, hence providing the people tracking function with an important requirement that is to check if there is more than one individual using the ATM at once. As an example,

if there are more than two well-built individuals (adults) present inside the ATM, which could pose as a threat to the security of the premises, and so it will be detected by the people tracking function of the system.

Facial Recognition - As a security measure, many banks worldwide do not allow their customers to wear and form of headgear or any accessory (i.e. sunglasses) covering their face, inside an ATM. The reason behind this, is to ensure that no one is misusing the ATM or performing any fraudulent activity inside the ATM – all the while hiding their faces from the security cameras. This rule acts as the requirement for our system's facial recognition function. The video captured from the pinhole camera inside the ATM will be processed using the facial recognition algorithm. Once the algorithm is running, if the system does not detect any facial features of the individual using the ATM, it will be classified as a threat and the security personnel will be notified.

Behavior Detection - If any individual/s using the ATM showcases any kind of suspicious behavior, the behavior detection algorithm will identify the said suspicious behavior as a threat to the security of the ATM. The behavior detection model of the system will be able to detect if a person is trying to vandalize the ATM using physical force, which of course will be classified as abnormal behavior.

2.2.3. Abnormal Object Identification

Abnormal object detection and segmentation – In simple terms, segmenting the required area of the abnormal object from using image-processing techniques such as background subtraction, feature extraction, edge detection etc.

Motion Tracking – After segmenting the object from the it's background, the pre-processed image would be tracked by comparing simultaneous frames from a set of simultaneously taken images from a CCTV to allow to identify either the position the pointer should be in or the abnormal object.

Abnormal object identification – After tracking the motions of the pre-processed object, the abnormal object would be identified according to the outline template.

2.2.4. Parallel Processing

Parallel processing will open doors to more effective and efficient running of the entire service being created. The different modules incorporated into the service in the identification and notification of abnormalities will be broken down into their individual smaller processes and aligned for smoother processing, with the use of multiple methods, techniques and tools to achieve this.

To ensure real time abnormality identification the processes developed will be run in parallel to the breaking down of the live video feed coming into the system. This maximizes integrity. The processes identifying the abnormalities will also run in parallel to one another.

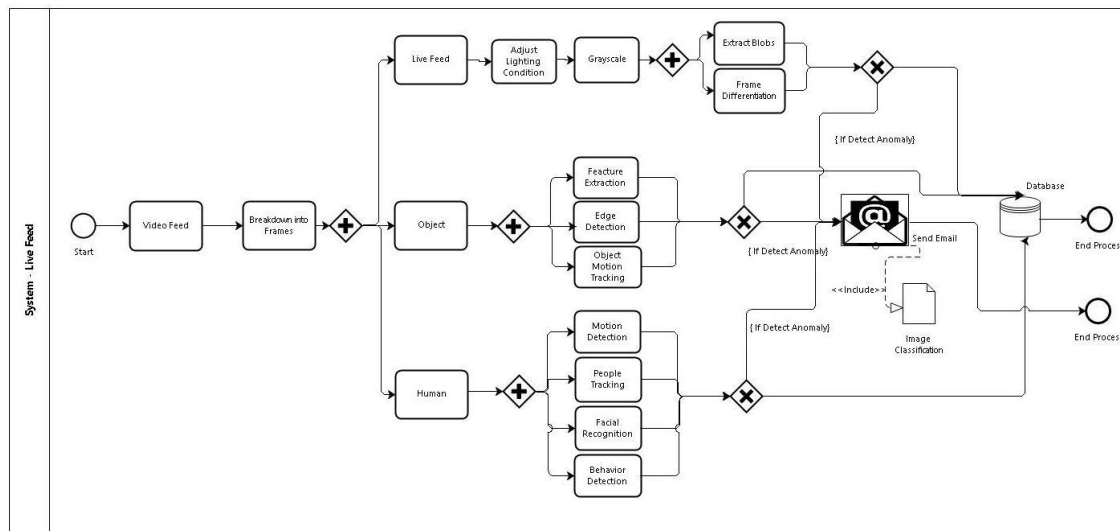


Figure 2 Process Flow Diagram

2.3. User Characteristics

The service, abnormal human behavior identification is mainly applied to surveillance systems operating in a banking environment. Since this is an automated process, the users associated with this system are limited. However, once an anomaly in the ATM environment is detected, the security personnel of the bank will be getting a notification email prompting him to act to prevent/control the threat.

User Type	Description
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Security Personnel	The person who directly involved and responsible for the bank security. They should have the ability to operate a Windows PC and should have sound knowledge and practice of handling emails.
Researchers	An interested party who is experimenting or conducting research related to enhancing the security in a video surveillance system in an ATM.

Table 1 Description of Users

2.4. Constraints

Since the system is based on a surveillance network in a banking environment, it is limiting the developers' work, in terms of obtaining actual footage from an ATM camera for testing purposes, because the said video footage is considered confidential and would be against the bank's regulatory policies involving the identity of its customers.

For parallel processing, the constraints come through the available resources, the processing capabilities of the existing system will tell the developers how much they can allocate for processing of the service.

The module will be developed on C#, installed on a Windows PC.

2.5. Assumptions and Dependencies

We have found few assumptions and dependencies, that the security office should consider after we implemented the application ATM.

- Notifications need to be identified by the security personnel to ensure the safety of the ATM.
- The security personal must react immediately to avoid further damage.

2.6. Apportioning Requirements

All the requirements mentioned under product functions section of this document functional requirements category of the system, and they are to be implemented in the system in its first release. The methodology of implementing the system may slightly be different than the content described in this document during the system design however the

requirements specified will not be changed and the systems release will tally with its purpose and objectives.

For parallel processing, the requirements that were stated are to be implemented fully, the entire solution depends on the back-end service done by the parallel processing module to run smoothly. There are no broken-down requirements of the module that can be apportioned. The entire requirement of breaking down the processes and aligning it for efficient running of the solution.

Additionally, the requirement of processing feed of many other cameras in parallel to the ATM cameras, may be looked at as future enhancements when the solution wants to expand its capabilities.

3. Specific Requirements

3.1. Classes

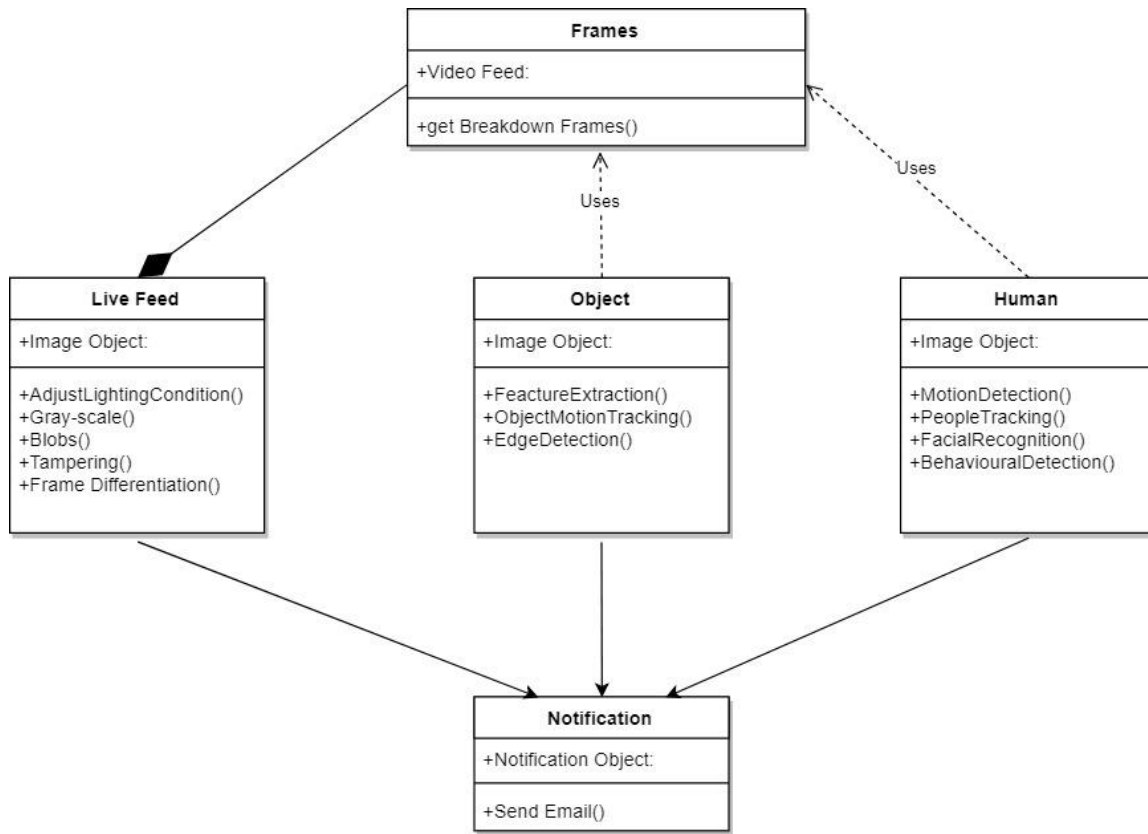


Figure 3 Class Diagram

A main class will be created to incorporate the parallel processing methods and attributes. The existing C# libraries available for parallel programming can be used for the development of the module.

3.2. Performance Requirements

This product will be built to function itself without any interaction with other external systems. For efficient performance of the system, the system should use machines running Windows with a minimum speed of 1.80 GHz and 4GB RAM. The overall performance of the application is determined by the CPU and the RAM working together, as well as GPU Processing power.

3.3. Software System Attributes

3.3.1. Reliability

In a system such as this, that deals with ensuring the security of a banking environment, the reliability is a crucial attribute to be looked at, which is why the proposed application is being developed to in a way it will perform the functions for which it was designed or intended for a specified time. All the latest technology is used to provide the precise service and, in less time.

3.3.2. Availability

Since all ATM transactions takes place 24 hours a day, every day, the system needs to be available during that time as well.

3.3.3. Security

It is essential that the ATM network be totally secure against any conceivable type of attack. Security is a very important characteristic for this type of application because all the details that are provided to the system must be valid and accurate.

3.3.4. Maintainability

The maintenance ability is an important aspect since it is intended to be improved further in the future. Standard coding practices will be followed during the implementation of the system. The system will be implemented to minimize bugs and errors as much as possible.

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