Object Detection Bot

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Abstract - *Internet of Things (IoT) is an ever-expanding network of smart and functional items. For security and safety applications, unambiguous object detection is critical so that no events are missed and no resources are wasted due to false alarms. The deep learning and IoT services are available on cloud platforms, which can be leveraged to build a fully automated and failsafe security solution. Safety and security have always been a requirement for urban civilization. By combining an application operating on an edge device with AWS cloud services, our research presents accurate object detection for indoor and outdoor settings. Our project's main goal is to save human labor by developing and deploying a safety and security system that automatically detects plastic bottles, the presence of metal cans, or abandoned baggage while utilizing IoT and cloud-based services to reduce setup costs. For the compute-light detection task, we discover that AWS Rekognition has a lower delay and is cost effective than all other cloud platforms. We provide results for identifying plastic bottles, detecting tin cans and monitoring any abandoned bags that might be a potential threat to society.*

Key Words*: *Internet of Things, Object detection, Deep learning, AWS cloud services, AWS Rekognition,

1. INTRODUCTION

Surveillance systems are placed at various public locations to prevent littering or possible threat from an abandoned bag. Owing to the advancement in technology, it is difficult to monitor the CCTV feeds all week, thus demanding the need for a robust security mechanism that alerts the necessary security personnel in-case of incidents of public littering or threats from abandoned baggage. The objective of this paper is securing outdoor environment by building an autonomous bot using a Raspberry Pi, sensors and camera modules. Cloud platforms have a worldwide presence, allowing data and applications to be accessible with minimal latency due to the physical proximity of cloud servers, which benefits both data producers and users.

The Amazon Web Services (AWS) cloud platform is the most mature cloud platform with the most cloud services. AWS offers a variety of services that may be used in conjunction with IoT to create a complete smart security solution. The Amazon Web Services (AWS) cloud platform is the most well-known cloud platform with the most extensive variety of cloud services. AWS provides a number of services that may be used with IoT to build a complete smart security and safety solution. Images of bottles, baggage are stored in the cloud, and in the presence of plastic bottles or baggage is detected, the bot captures the image, send it to the AWS cloud, and compare that with hundreds of images in the database. When the image matches with the images in the database, the security personal is alerted and necessary actions are carried out.

2. LITERATURE REVIEW

A few recent works on real-time object detection were recently reported. The report's contents are weighed in terms of their benefits and drawbacks.

Cleanliness as well as safety at outdoors are traditionally led manually by humans or surveillance system, which are not that efficient as well as not accurate. There are a few smart systems on the market that use electronic sensors put on the cane, but these systems have several drawbacks. Using the notion of motion detection, the authors of [1] created an IoT-based smart surveillance system. The systems architecture consists of raspberry pi, a webcam, a GSM module and Wi-Fi module that detects, captures images and notifies user . This system suffers from certain disadvantages like inability to perform object detection , causing not only false positives but also not having the ability to exclude certain trusted detections . Nag et al. [2] proposed a facial recognition and detection algorithm-based security system for accessing doors. The authorized user receives the incoming data from the Raspberry Pi via the Telegram application. This approach relies on HaarCascades, an ancient method for detecting faces that takes a lot of memory.

Hassan et al. [9] use face recognition to lock and open the door. To create security solutions, [4] and [5] employ Raspberry Pi and IoT sensors. The paper "Indoor Autonomous Vehicle Navigation—A Feasibility Study Based on Infrared Technology" [6] discusses how sensors may be used to motion and presence of humans, both of which are important for security. Karri and

Daniel [8] suggested a GSM-based SMS-based system. Instead of sending a traditional message, they utilize the web to communicate with as well as notify the user.

An improvement was made to the system was made in [9] by making use of OpenCV python library and Local Binary Pattern (LBP) algorithm . Instead of just capturing the image, the system switches on the camera only when motion is detected and performs facial recognition. The systems developed in [1],[11] and [7] work well on small scale and are also cost effective but they do not provide the scalability and performance needed for complex use cases.

3. METHODOLOGY

3.1. Detailed design

This is a hybrid model in which machine learning inference is performed locally at the edge to minimize transmission latency while still connecting to cloud services. A product perfectly catered to this problem is AWS service is AWS Rekognition. It provides cloud-based management, analytics and storage. Another important aspect of this project is the ability to do machine learning inference at the edge utilizing models developed and trained in the cloud using Amazon Sagemaker or models saved in S3.

The proposed system would identify objects locally on the Raspberry Pi utilizing SSD object detection using models developed in Amazon Sagemaker or pre-trained models made accessible in S3 that may be consumed directly by edge devices. The edge device will also send detection data to the AWS Simple Notification Service, allowing the user to be notified when detection happens. Finally, the video will be transmitted to Amazon Kinesis, where it may be seen and accessed using a publicly available media player using the HLS protocol.

3.2 System Architecture

Figure 1 shows a block diagram of the proposed system, which gives a high-level understanding of how the main components of an object detecting bot would operate. The Raspberry Pi OS will be installed on the 16GB MicroSD card, which is an officially supported operating system.

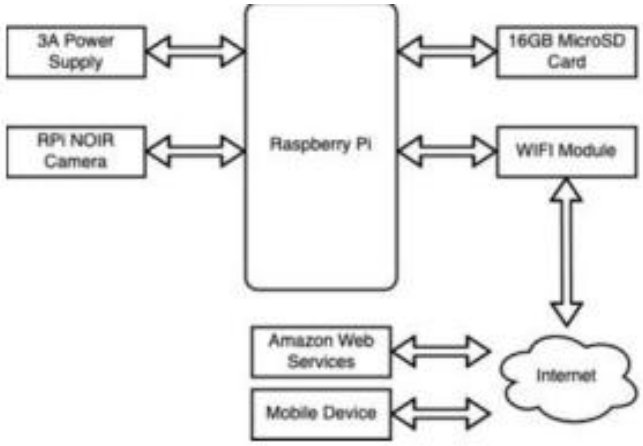

Figure 1. Block Diagram of proposed Object detection Bot.

A mix of local edge computing and AWS services is required to construct the system described in Figure 1. Figure 2 depicts the AWS services that will be required for the Object detection bot. The video feeds from the Raspberry Pi will be ingested by Amazon Kinesis, which will store them in S3 and allow users to watch them.

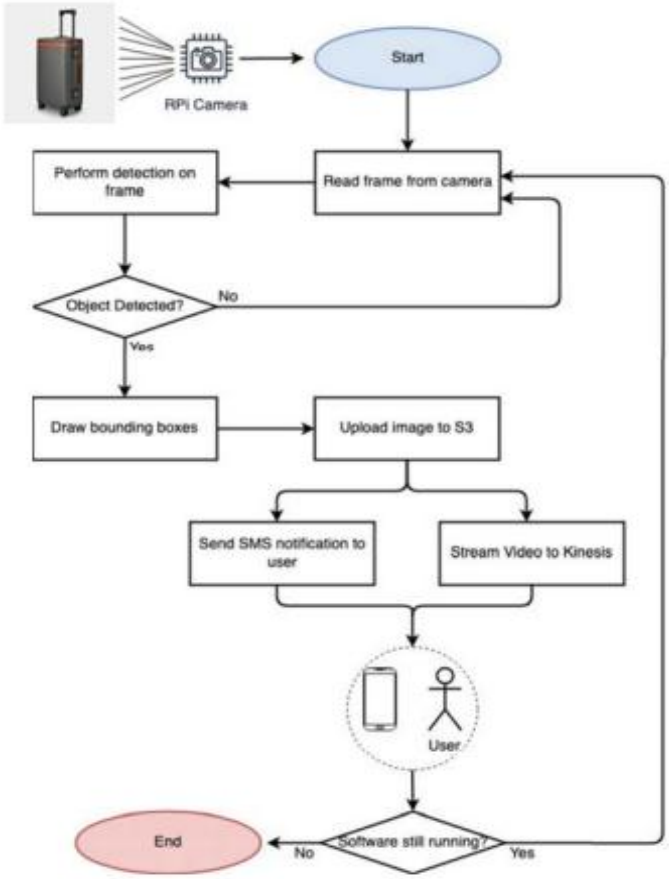

Figure 2. Flowchart of all the AWS services used by the Object detection bot

3. CONCLUSION

In this paper an object detection bot was conceived and built utilizing a Raspberry Pi 4 and cloud computing to deliver IoT capabilities and services in this study. Using the AWS Rekognition allowed the ability for an object detection bot to be built. This meant that the system could be updated or altered from a single place and then delivered to all edge devices at the same time. It also allowed you to quickly switch between an Amazon Sagemaker-trained model and an alternate pre-trained in S3 model.

Notifications were received within seconds of detection occurring. The findings of this paper show that building an Object detection bot using the combination of local edge compute and cloud computing is a feasible solution on resource-constrained devices .

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