Implementation Of Visitor Count Using AWS Platform

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Abstract—Video Surveillance has been a major part of providing security to homes and commercial stores. In this paper, we have discussed about an IoT project which helps to bring out the count of total entries and total exits of particular place when this machine is installed and simultaneously the data will be stored in the AWS DynamoDB service, with the help of AWS API gateway service we can project that data on a web page. We can use this machine in classrooms so that we can validate the count with physical attendance. This machine can be installed in commercial areas like shopping malls with the help of this owner of the malls can get a report of how many number of customers entered the shop and the number of people who purchased the item and the customers who left without purchasing items. The same data can be utilized by product-based companies, with the help of this data they could make good marketing at places that have more visiting of customers and increase their brand value. The same machine can be used at the time fire accidents in building with this we can find out how many number of persons who are still inside the building.

I. INTRODUCTION

Nowadays video surveillance has been the major part of providing security in the real world. It helps to monitor the surrounding without depending upon human resources. In this paper, we have discussed a machine which gives the count for the people who are coming in and moving out of any particular location. Simultaneously the recorded data will be stored in AWS DynamoDB service where our data remains safe and secure. Now to view our data on a web page we made use of the AWS API Gateway Service through which we made a user-friendly web page to show the data. This system can be installed in commercial stores like shopping malls which helps the owner to get the report of the number of customers who visited the shop and number customers who left out without buying anything. So that based on this particular data the owner can make the appropriate change in shops and arrange the items that are required for the Customers so that he could boost up the sales. The same type of data can be utilized by the product based companies to have good marketing for their products and this can be done only in the places which have high people count. This can be fixed in the places like apartments and buildings, so that when any natural calamities like earthquakes or fire accidents with this system we can get a count of the people who are still inside. There were many experiments, projects and devices that were made on people count those were discussed in the observation section.

II. OBSERVATIONS

In recent years video surveillance has been playing a vital role in the field of security to the real world. The use of video surveillance is not only permitted to the commercial store but also for housing environments. If you see in the past years there were many devices have been launched in the market to get the people to count. The most commonly used sensor was the IR sensor with Arduino where two IR sensors were used to get the count of people who are inside. When a person passes from IR sensor1 to another IR sensor 2 then count is increased and when person passes from IR sensor 2 to IR sensor 1 the count is decreased, the problem with is system is that when two-person moves in bidirectional ways it becomes difficult for the IR sensor to give out the results and make the wrong count. The people count report plays the main role in commercial stores where the store owner cannot keep on seeing the customers, if they appoint any human resource then they must provide finances to that person and there is a huge chance of making errors. If you look at the market there are devices like "Smart non-directional wireless infrared sensor display people visitor counter" which is available in Amazon, the problem with this particular device is that the sensor inside it is way too sensitive. The sensor catches the shadow and its sensitivity to a reach is more obnoxious. Sometimes it will also catch the multiple shadows of the same person. When a person with the large arms passes through it takes multiple counts for that person. Now when you look at image processing for the people count there of the machines which use Matlab for image processing. The problem with Matlab is that it is very costly only a few can afford it. Another thing is that during the cross-compiling or converting Matlab to other language code it makes very difficult and person must require high knowledge on Matlab to solve errors and is difficult for a beginner to do. There are some systems which use centroid tracking algorithm are used which works well and good but they have not connected into any cloud platform to store the data in cloud and process that data whenever they want. In this paper, we have used and connected our people count system with world best cloud service provider Amazon Web Services which is a better, safer and secure cloud platform till the date and generated our data on a webpage. Some related works were done based on people count and connecting to the AWS cloud platform which was discussed in the related work section.

Index Terms— People count, AWS DynamoDB, API Gateway, Video Surveillance, marketing, security, shopping malls.
III. RELATED WORKS

In the paper “Bidirectional People Counting System in Video Surveillance”, written by Satish D. Pore, B. F. Momin. Here they have discussed the people counting system and here the counter flows two steps: 1) Detecting the people and tracking the direction in which people move. 2) Detection is based on finding people with the help of the HOG descriptor and trajectories of people that are generated through the application of the Kalman channel. Finally, the counting system modifies in and out count based on the direction of trajectories generated by the Kalman filter. Here they have used Hog descriptor to detect the human in video and later based on direction trajectories the counter is updated and they have used Kalman filter which is a linear and recursive method which has two stages like guess and modification and in prediction phase, it estimates the motion while the correction phase corrects the errors. There is a small remark on Kalman filter stating that as it is linear it is only capable to hold only a single estimate. Therefore for every new human detected it is necessary to assign a new filter. In the paper, A People Counting System Based on Face-Detection authors are Tsong-Yi Chen, 1 Chao-Ho Chen, 2 Da-Jinn Wang, and 1 Yi-Li Kuo. Here in this paper, the authors have discussed the people count in which their system is going to detect the number of people that are passing through the gate or door using face detection. They first made use of frame difference to detect the rough edges of moving people and then they used chromatic features to detect the faces. Using NCC (Normalized color coordinates) color space they are going to identify whether it is a real face or the fake one. Later the tracking of that particular face is done and counted which passes the counting line. The authors have used four main components like moving objects segmentation, skin color detection, face detection, and counter. They have used a frame difference method to extract the edge pixels of the crowd by using dilation technique of morphological processing.

In the paper Design of people counting system using MATLAB authors are Surbhi Saxena Dalpat Songara have discussed the people counting system where it counts the visitor's count but here they have used Matlab. Here to have the automatic face count they have used viola Jones method of facial recognition to detect people. In the paper, A Prototype Air Flow Control System for Home Automation using MQTT over Websocket in AWS IoT Core authors are Nadia Imtiaj Jaya and Md. Farhad Hossain. Here in this paper authors have discussed the system to control the Air. The airflow control system is dependent on temperature and humidity. Here they have used the AWS IoT cloud platform which makes an easy connection between device and application. For this project they have used NodeMcu as their micro-controller which has built Wi-Fi and sensor like dht11 for temperature and humidity. As a communication protocol the light weight, low power consumption and impenetrable MQTT protocol over web sockets. AWS IoT will monitor the temperature and humidity values and take necessary action based on these values. Here in this paper, they have just discussed the publishing and subscription of the topic to the devices, But they haven’t stored any data on DynamoDB neither they projected their values on the web page. In this paper, we proposed a system that gives the count of people who is going in and going out from a particular place where we have used raspberry pi 3b+ module and used centroid tracking algorithm, object tracking algorithm to get the people count. In this system, we can use a recorded video to get the people to count or can use the webcam for the live count. This raspberry pi is connected to the AWS cloud platform so that the data will be saved in AWS DynamoDB and with the help of AWS API Gateway the data is displayed on the web page. A Clear explanation of every module that we have used was discussed in the Modules used section.

IV. MODULES USED

The centroid tracking algorithm is also known as the object tracking algorithm as it depends upon the distance between the object centroids which are in existence and also in the new object in between the frames in a streaming video. This algorithm applies a unique ID to each object which is tracked and allows you to count the unique objects in a streaming video. It is the best algorithm for building an accurate person counter. This is one of the standard basic models for computer vision and also for the image processing algorithms and there are many various tricks to help improve the trackers of the object. In this project, we used the centroid tracking algorithm along with the open cv. The process is as follows. Firstly it takes the starting pair of the object as an input and sets them as the box coordinates. Creating a unique ID for each of the initial detection objects. And then tracking each of the objects which they move in the frames of the video and maintain the records of the unique IDs.

The steps are as follows

Step 1: Taking the boxes which are bounded and evaluate the centroids

Fig 1: taking boxes and evaluation the centroids

The tracking algorithm assumes that we are passing in a pair of the bounding box (x, y)-coordinates for each detected object in every single frame in a video. these boxes are produced by any type of detector which is provided and calculated in every frame in the video when the box coordinates then we calculate the center (x, y) coordinates of the box and assign the unique IDs for them.

Step 2: Calculating the distances between the existing and new boxes objects

Fig 2 calculating the distances between the new and existing objects

For every frame in the streaming video we apply the process of Step #1 of object centroids; instead of assigning a new unique ID to each object which is detected we first need to determine that it is possible to associate the new object centroids (y) with the old object centroids (p) or not. To
complete this process, we calculate the distance between each pair of existing object centroids and object centroids which are given as the inputs. From Figure 2 we have detected the three objects in our image. The two pairs which are close together are two existing objects. So that it is easy to calculate the distances between each pair of original centroids (yellow) and new centroids (purple).

- Open CV is an open source computer vision library. Computer vision is the way of teaching intelligence to machines and making them just like humans happens when a human and image to recognize the places which are there inside the images computer vision is not allowed computer to see and process visual data just like you computer vision in walls analyzing images to produce useful information to some exam after driving car it can detect the lane using computer vision might have wondered how Facebook detects images when you upload the images of you with your friend becomes possible by Facebook space and image recognition technology Fauji so now what is open saving so open source computer vision is a life of programming function main aimed at real-time computer vision developed by Intel and later supported by a developer called below garage and it is supported and maintained by ITC available on Mac Windows and various Linux. Operating system Open CV is a cross-platform library now you can open field using C++ or Python. Open CV now is an open source and free library which is licensed under GST license that it is very easy to use and install that we will see when we will install open CV on various operating systems.

- It's free for use under open source license library is one of the most widely used packages for detection motion detection and recognition and event deep learning facial recognition applications use cases for open CBR 2D and 3D feature to get the facial recognition application which is one of the most widely used applications of computer vision gesture recognition motion understanding object detection and segmentation in recognition of cases on open CV and give you to understand start go to script directory. NumPy is the elementary package for scientific computing with Python. It contains among various things. It is a powerful N-dimensional array object and has sophisticated functions. It is the tool for integrating the C/C++ and algorithmic language code useful pure mathematics, Fourier transforms, and random selection capabilities. Besides its obvious scientific uses, NumPy can also be used as degree economical multi-dimensional instrumentality of generic data. Discretionary data-types are typically printed. This allows NumPy to seamlessly and speedily integrate with an honest form of databases.

- Dlib is one of the C++ toolkit which contains the machine learning algorithms and also useful to create all difficult software in C++ to solve the many problem statements. It is used in all trade associated domains and used to pass the domains which are very big in range in conjunction with the help of the AI, embedded devices, smartphones, and massive computing environments which are high performed and it offers the licensing and permits every individual to use it in any kind of application with free of charge. IMUTILS is the series of the many functions which are used to make basic image operations like rotation, translation, and resizing and displaying the MatLab lib footages in a very easy way by using the Opencv and python.

**MQTT Protocol**

The Mad Dash to connect virtually every noun to the internet the so-called internet of things creating a massive machine to machine network so that all of the devices and sensors and Systems and actuators can connect to and communicate on the internet and with that, they need Communications protocol so understand each other one of those protocols is message queue telemetry transport. MQTT is a TCP based subscribe and publish messaging protocol is design for lightweight machine to machine communication UC not only are we interacting with IoT devices sensors out there but the Machines themselves are communicating with each other on the back end without knowledge in fast mode IoT data centre traffic is the machine traffic it was originally developed by IBM and it's based on a hub and spoke model MQTT (Message queue telemetry transport) it is a nice lightweight publish and subscribe system by which you can publish and receive messages as a client and it makes it easy to establish communication between multiple devices it is a simple messaging protocol design for constrained devices and with MQTT protocol so it's the perfect solution for internet of things applications is quick high-level. The MQTT allows you to do you can send the command output or you can read data from a sensor and publish it in MQTT there are a few basic concepts that are need to send messages topics broker the concept is the permission subscribe system admin this means that the files can publish messages to your other devices for your device can subscribe to particular topic save those messages for example on the topic used to describe the same topic as device for is publishing in so device to receive the message messages are the information that you want to exchange between your devices whether it's a comment or data with the publish-subscribe system you can do pretty much anything you could ever want in your home automation project another important concept is topic topics are the way you Rises that interest for incoming messages for a specified you want your message to indicate that create
AWS IoT: We know that Amazon is one of the leading cloud service providers in the world. It is a secure cloud service platform which offers to compute based on your requirement of the speed that you want, it also provides the data provide the data storage platform to store your data there are many other features which are provided by AWS and AWS IoT is one of them. AWS IoT is a platform which was provided by Amazon so that you could be able to know the state of all your devices. Many companies in the world that use their AWS have their IoT platform companies like Enel Power Company from Italy which uses a w platform for energy management green grass enabled gateway power generation. Mining companies like Rio Tinto uses AWS IoT working in green grass to determine real-time heat maps of road roughness heavy equipment financially beneficial. One of the leading electronic companies like Philips of a uses it for creating a better Healthcare monitoring for the upcoming project. Amazon helps them in providing edge-based software’s like AWS Free RTOS, AWS green grass, AWS IoT Core, AWS device management, AWS IoT Device Defender, AWS IoT Analytics. AWS Free RTOS and green grass this both services help maintain a secure connection with the devices. These services are also used to collect the data from the devices. These services help to take intelligent actions based on the circumstances. It also works when the internet is down. These services help to monitor a large number of devices so that you can keep them safe and secure. AWS IoT Analytics helps users to analyze their IoT data and also can be easily integrated Amazon quick Sight for visualization and Amazon Saga maker for hosted machine learning. The great thing about Amazon Web Services is that all AWS IoT services are serverless means we can take full benefit of elasticity for enterprise applications they need not worry about the scalability of the applications. AWS is strictly confined the word pay only for what you use. It fully manages analytics service to easily analyze the data obtained from your device. It can perform analytics a large volume of data. Filters important data before being stored in the database. So that you can easily analyze the data in the future.: AWS Free RTOS is a real-time operating system, Is mainly used for microcontroller-based edge devices. It's your device secure credentials key management. It keeps your data Secure with a transport layer encryption And also provides firmware service Integrated code signing which keeps your devices up-to-date. Amazon Greengrass is used for more powerful edge devices like gateways Programmable Logic controller which runs on Linux. It takes functionality to the local devices so that action be taken quickly.

AWS IoT Core:
It acts as a backbone for IoT deployment and securely connects all the devices and to handle the data. It allows you to route your data also process your data and to act on the data which has been received from end devices. It has been given more priority in AWS IoT core you have built-in devices authentication and authorization to keep your IoT solutions safe.

AWS IoT Device Defender:
The main purpose of the IoT device defender is to continuously audit policy that is associated with your device. Also, monitor your device behaviour. Let’s the end-user know anything goes wrong

AWS DynamoDB:
DynamoDB is a quick and elastic non-relational database service which is for any scale of applications. DynamoDB is an example of NoSQL database service provides faster and predictable performance with seamless scalability. It enables the customers to think about the project rather than the administrate burdens of operating and scaling distributed databases so that they don’t need to worry about the hardware setup. DynamoDB supports get/put operations with the help of a primary key which is made at the time of the creation of the table. With the help of the primary key, you can get or put an item into the table of DynamoDB. A predominant key can be of a single-attribute partition key or a composite partition-sort key. Single partition keys can an Empid through which we could get the item or a row from the table and you can also place an item in the table with the help of this key. Table, items, and attributes are the core components that we would work with. Some of the features of the DynamoDB are Scalable, fast, easy administration, flexible, Strong consistency, secure and many more.

AWS Lambda:
It is a computing service provided by amazon which helps you to run your code without the help of other servers. Its elasticity nature helps to accept the requests depending on your requirements, only runs the code when you need it. When you add code to the lambda the carrier will take care of the things like scaling patching and administration of infrastructure to run your code correctly and exhibit remarkable overall performance via publishing real-time metrics logs to the AWS cloud watch. It is of low value and does now not require any upfront investment. AWS Lambda will charge a less amount of fee per request that you have received. There is no need to learn new languages at frameworks that need to learn to get started with AWS Lambda. The code which is deployed on AWS Lambda is called Lambda function and we can see results on console of AWS Lambda. You can upload your code in AWS Lambda by uploading a Zip file or by typing your code in the console itself in the environment provided by AWS. There some pre-build functions and sample functions that are present so that you don't need to start from scratch. There are also some built-in as SDK’s so that you can connect AWS Lambda locally from your computer. Lambda supports languages like Java, go, PowerShell, node JS, C#, Python and Ruby.

**AWS Identity access management:**
AWS IAM is a service provided by Amazon to give a specific set of permissions to access the other services in AWS to the specific users. It makes use of the access control concepts can define which users have permission access or to update to make changes in the other AWS services. Deploying your applications on AWS you can give out less time and effort in Administrative Service, while we can concentrate on other things like making sure everyone gets what they need. It allows the customers to focus on the quality and performance of the application whereas it takes care of the security aspects.

**AWS API gateway:**
AWS API Gateway is a fully controlled service provided by Amazon to developers/customers to create, publish, maintain, monitor, and secure API at any scale. With the help of API Gateway developers can create restful API and Web Sockets API that helps to enable real-time two-way communication for the application created by the developers. API’s that are created in AWS API Gateway behaves like a front door for the applications to access the data to make business logic and functionality from your backend services.

**HTTP API:** With the help of HTTP API you can build high-performance restful API which requires an API proxy functionality without API management features.

**REST API:** REST is software that helps to set conditions that are used for web services. REST is always focused on a web-based application. It mostly handles the responses and requests of HTTP. It is used to create/build lightweight web-based applications can be easily handled and scalable. Most people are moving to REST because most of people use mobiles and applications in it are cloud-deployed.

**Web sockets API:** Web socket API is a technology that helps to make the user to have the communication session between the browser of the user and the server. It makes the help of API, there is no need to poll the server for a reply to send and receive messages to the server. With the help of API Gateway has no minimum fee or startup fee required to pay. You need to pay only for the API calls that you receive the amount of data transferred out. Three options provided in Amazon API Gateway they are HTTP API, rest API, Web Socket API.

**Cross-origin resource sharing (CORS):**
It is a Mechanism that allows one website to access the resource of another website using JavaScript. It can also be said as a technique that tells the browser whether a webpage is a website/application that can fetch resources from different domains or not. CORS if necessary maintain the connection between the servers landing resources because save your assets from harmful malicious content. It also provides you easy access to the multiple sources across the internet. We have used all the above modules, detailed and sequence of implementation of the system is explained in the Implementation section.

V. IMPLEMENTATION
Raspberry Pi: After successful execution of the people count code Raspberry Pi with the required libraries and now we need to connect it with AWS IOT console. To connect Raspberry Pi to AWS IoT we need to download the AWS IoT SDK from the amazon website and the paho MQTT library also needs to install.

The some of the requirements like python version must be 3.7 and OpenSSL to connect AWS IoT core.

You need to catch all the required certificates which were made at the time of creating a thing in AWS IoT.

AWS IoT Core: After successful attachment of the certificates to the Python program in Raspberry Pi now good official website and check whether receiving the data from the Raspberry not.

It can be done by visiting the Test section and here you need to enter the topic name which is given in the python code, in a few second’s you can receive the data on the console.

Dynamo DB: After displaying the data on the AWS IoT console now we need to store the data into the Dynamo DB.

Further, we are going to create a rule stating that data displayed on the console is stored in one of the dynamo DB with the help of the primary partition key. After creating the particular rule your data will be stored in the dynamo DB automatically.

AWS IAM Service: AWS identity and access management service is a service provided by Amazon which plays a key role in providing security credentials accessibility to access services dynamo DB, AWS IOT another set of services Amazon Web Services.

Later we need to create roles so that other services can attach those particular roles to access other services in AWS.

AWS Lambda:

Now we are going to process the data is stored in DynamoDB, here in the AWS lambda function we are choosing NodeJS programming language and we need to attach the policy that is created AWS IAM service to access dynamo DB table from Lambda functions. Saving the function testing it we could see the results in execution section of lambda function page.

API Gateway:

Now we need to display the values that are obtained in Lambda function for the web page that we are going to use API gateway which is one of the services in AWS. We need to create API choosing API type as REST API so that can get control over the request and response along with API management capabilities.

Now we need to select the Lambda function to deploy the API when you click over the link has been displayed we can see our data on a webpage in JSON format. Using Ajax we can get our required data formatted data from JSON formatted data and use it in we can design beautiful HTML pages.

VI. EXPERIMENTS RESULTS:

Uploading of Raspberry pi people count data to AWS cloud and video surveillance.
Fig 4.1: visualizing of the visitor count on pi

Displaying people count data on AWS IoT console.

Fig 4.2: displaying of visitor counts on aws iot console

Storing of people count data in Dynamo DB.

Fig 4.3: storing of data in aws dynamo DB service

Displaying the report of people counts on a web page.
VII. Conclusion: 
In this paper, we have discussed people count machine where this machine is connected to the AWS cloud platform and stores the people count data into the AWS DynamoDB and with the help of AWS API gateway the values in DynamoDB is displayed on the web page. This system can be used in commercial stores, buildings, and apartments. The retrieved data can be stored in DynamoDB which is safer and secure this particular obtained data can be used for multiple purposes. Based on the results we can conclude that microcontrollers like raspberry pi can be connected to the AWS cloud platform which is very good for small IoT business applications. Further, the obtained results can be given for analytics which is important to make good decisions for the future coming projects.

VIII. REFERENCES
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