A Smarter Office Automation System

Introduction

People say "AI is the new Electricity", we wholeheartedly believe in this Quote. Still we believe that today in this tech driven world where problems like climate change, power outage, blackouts, pollution and poverty exists, it's our responsibility to save the old existing Electricity which is the most important thing for survival. We wish to achieve our goal by using the power of Deep Learning and Artificial Intelligence.

The purpose of our project is to use the power of Deep Learning and Artificial Intelligence to solve the problem of Electricity Wastage and provide an efficient way of saving Electricity in offices. This will help in saving money for offices and will also benefit environment as, saving electricity will reduce the consumption of fossil fuels used for its generation. Minimal usage of fossil fuel will help us in taking a step closer to solving problems of climate change and global warming. As the whole project is build around saving electricity in offices, we have also developed few other Deep Learning models to increase the productivity and security in offices which has lead us to build a complete Office Automation System. These all things were possible because of the great implementation of "AI on the Edge" on Nvidia jetson TX2 Board.

Advantages

1. Most of the products available in the market which have a label of automation actually do not automate they provide you with an application to control the light's , ac 's or for that matter any appliance but now that we have implemented person tracking the process of switching on and off the devices will occur automatically.

2. Power saving will occur automatically as the appliance will be switched OFF automatically when the person leaves the premises.

3. Cost Effective. Hardware we have used in the product is very cheap and hence the production cost decreases and the market price of this product will be less than the currently available related products in the market.

Uses Of Jetson TX2

Most of the Algorithms that we have used in our product are Deep Convolutional Neural Network.

Deep Convolutional Neural network are 15 to 20 layers Neural nets with layers like Convolution,Relu and Max Pooling etc

All these layers requires lots of amount of computation power and time and the deployment of such model on a embedded platform for embedded applications is much difficult

Moreover our application works on taking live frames from camera which makes it even more difficult to deploy CNN on continuous frames

But due to the combined power of CUDA ,Cudnn library ,Pascal cores and Video Analytics capability of jetson TX2 board, deployment of Deep neural Network takes place with great speed and thus this is the perfect product for our project.

Technical Aspects

1)Face Recognition Based Attendance System

2)Person Tracking Based Office Automation

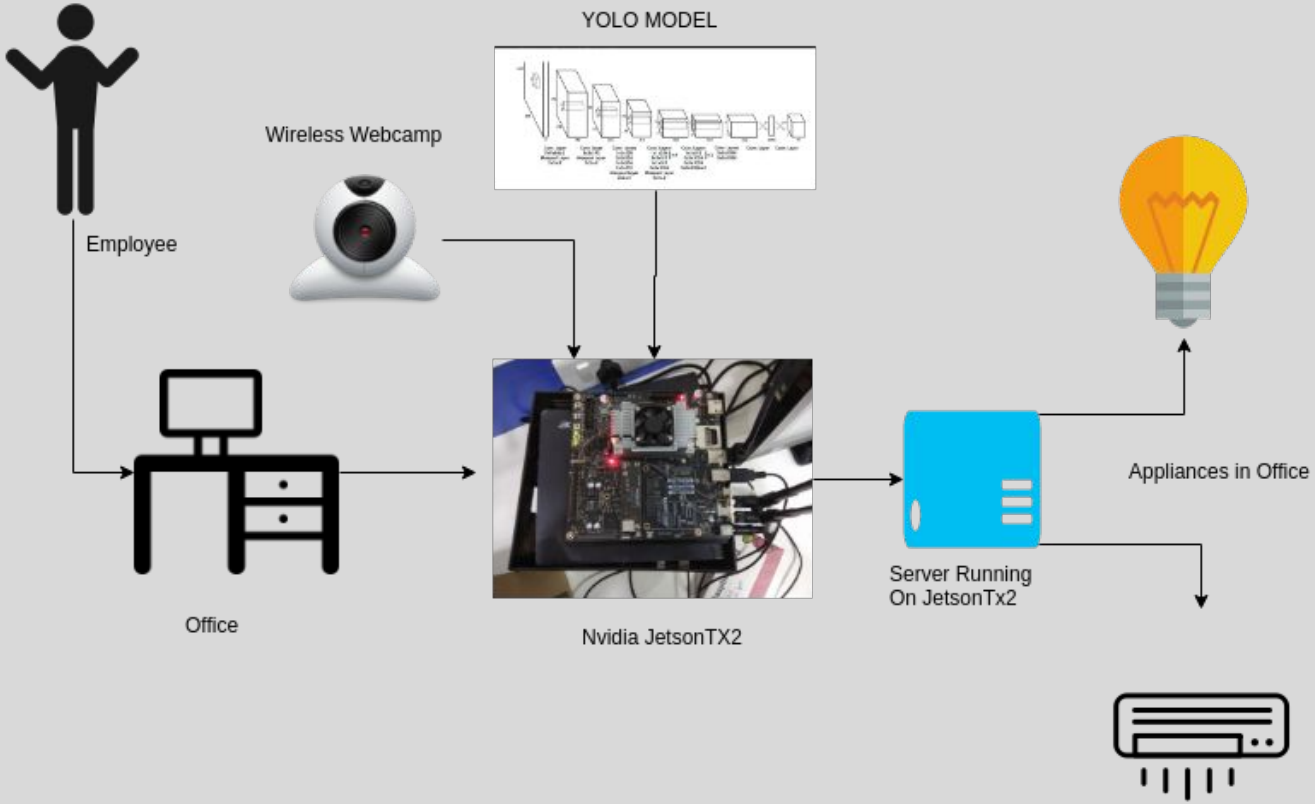
3)Inventory Management System

4)Crowd Sensing And Management

5)Office ChatBot

PERSON TRACKING BASED OFFICE AUTOMATION

Office Automation



Person Tracking based Office Automation

This Task is meant for detecting the count,position and absence/presence of employees in office rooms.

Basically it is a object/person detection task were we have used the state of the art Deep Learning Convolutional Neural Network known as YOLO(You only look once) which uses the architecture of Darknet -19

Our Implementation involved taking continuous video frames from a wireless camera Deploying YOLO using jetson TX2 board on the continuous frames and getting an updated idea of the number of people located in a room and accordingly controlling the electrical appliances

Node Js is used for server side and google firebase is the realtime database for sending information from Jetson Board to the connected Electrical Appliances

Advantages of our person tracking model

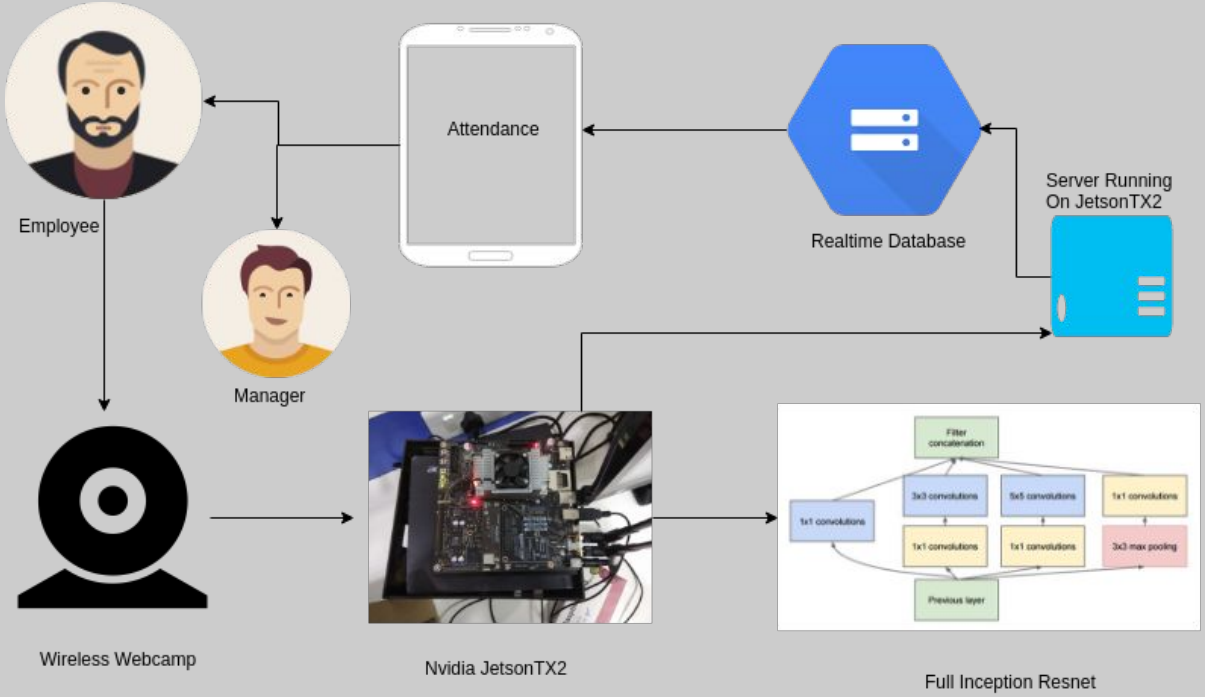
It is fully hardware based unlike the current autonomous system which require an app for operating the equipments

Our method of controlling appliances can save lots and lots of electricity which help lots and lots of people

The Switched that we use in our project are very cheap compared to the ones that we get in market for automatic switching

Face recognition Based Automatic Attendance

Attendance


Employee
Attendance
Realtime Database
Server Running
On JetsonTX2
Manager
Wireless Webcamp
Nvidia JetsonTX2
Full Inception Resnet

Face recognition based Attendance System

We have built a Attendance System which requires the most unique feature that every human being poses ie has face

For implementing Face recognition we have used Facenet model which is a currently used in many places for facial recognition system. Facenet is a Deep Convolutional Neural network based on the Inception resnet model

A wireless camera is mounted on the office entrance which is turned ON for a specific interval of time which is the bounding limit of office. The frames from the camera are then given as input to nvidia jetson TX2 board. The TX2 board then recognizes the person and his attendance along with the time is stored database.

The Attendance is then updated on the Office Assistant app that we have created for the employee

Advantages of our automatic attendance model

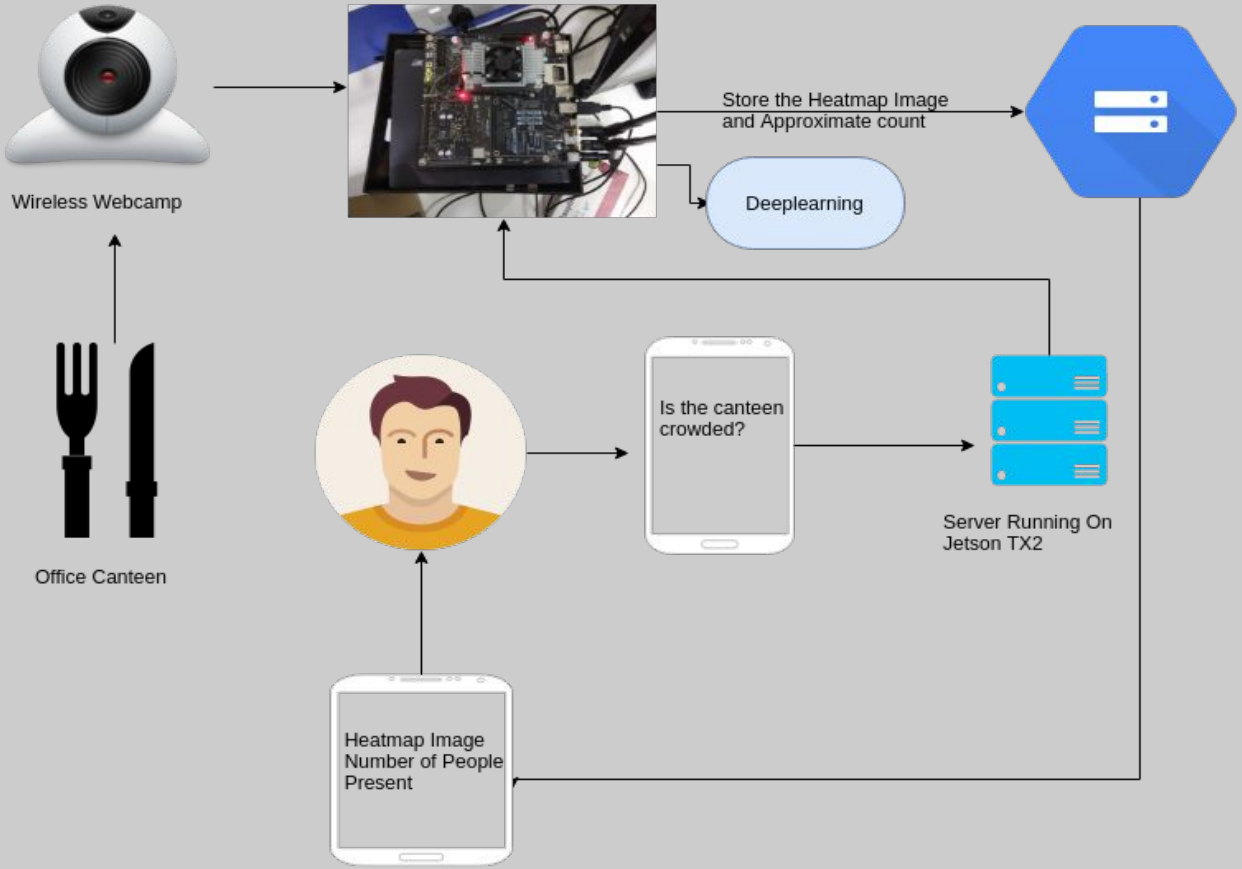
There are no requirement of bulky and costly fingerprint scanning machine which are way to inefficient and can be easily fooled

Our attendance system is far more reliable and secure and also for a person who has joined recently in a office his face also can be easily recorded and recognized by just providing one picture of that person

Our model uses the pre available material in offices and is cheaper that the bulky fingerprint scanning machine

Crowd Sensing And Management

Heatmap


Wireless Webcamp
Store the Heatmap Image
and Approximate count
Deeplearning
Office Canteen
Is the canteen
crowded?
Server Running On
Jetson TX2
Heatmap Image
Number of People
Present

Heatmaps - Crowd Sensing and management

Heatmaps is a novel approach applied mostly for the first time in office automation space which can be very much useful in case of emergency cases like Firebreak , Terrorist activities etc.

Heatmaps are implemented by using a 20 layer deep convolutional neural network whose output is a 2D image with some parts colored darker that specify the presence of a crowd in the room at that specific position. It can also provide the count in a room

Heatmaps can also be used by employees for checking if there is crowd present in the canteen or cafes . This could help them save their time and thus increase office productivity. For getting a heatmap the employee just have to send request through his Office Assistant app. The camera meant for heatmap will capture the frame ,send the frame to the jetson TX2 board and the jetson board creates and send an 2D heatmap

Advantages of our heatmap model

A unique step take in direction of office security and crowd management

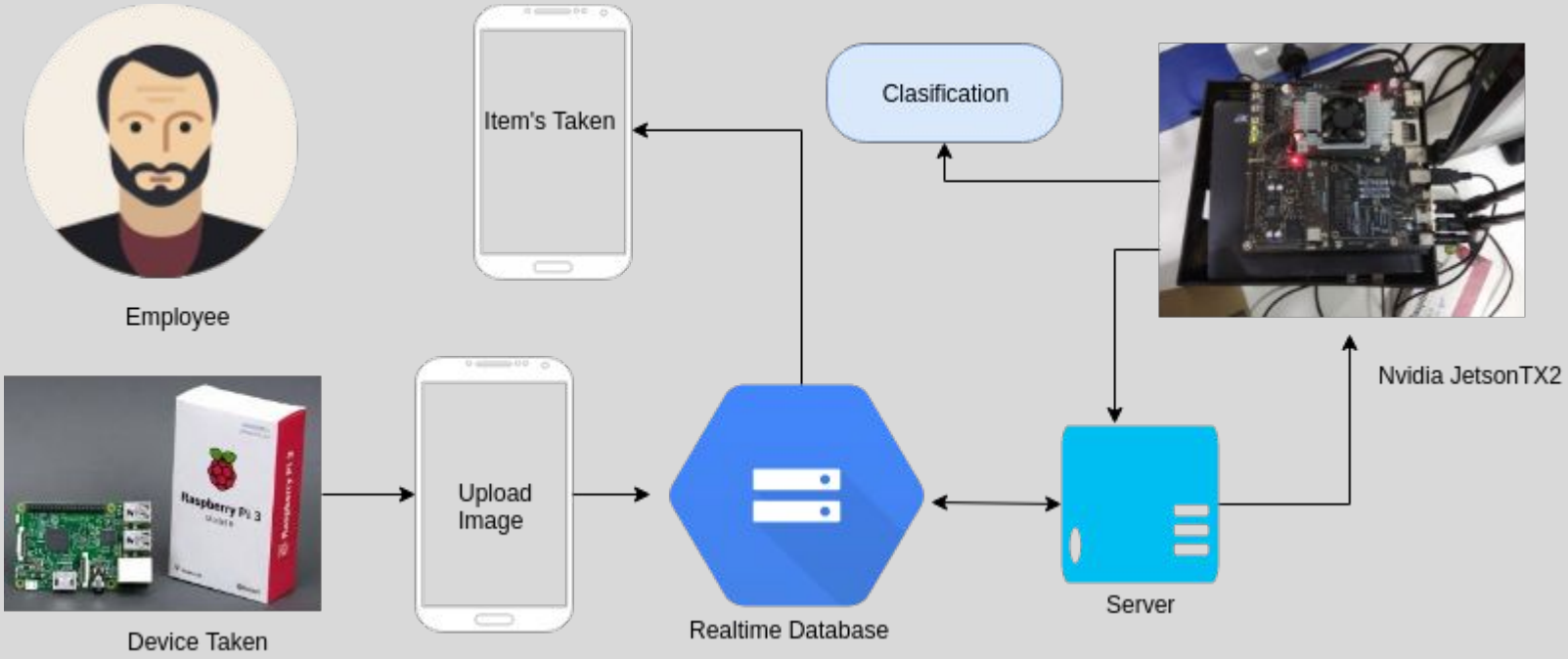
Improving productivity by saving time of the employees

The future version of Heatmap can help us calculate that for how much time was a employee out of his cabin or workspace

A very handy tool during emergency situations like firebreak etc

Inventory Management System

Inventory Management



Inventory Management System

This method aims at taking a step in the direction of eliminating the practice of ”Entering ” data in the database where data can be easily entered in a automated way

Certain companies have equipments and stationary for their employees . The Office needs to keep a track on the equipments to be used in a database along with the employees who use it.

We created an Convolutional Neural network for classifying objects in office . So whenever a employee wants to take an equipment he just have take an image of the equipment, upload the image on the Office assistant app then image is classified on the Jetson board and the product name along with employees name is directly stored in the database which is accessible by the manager.

Advantages of Inventory Management system

This method is far more efficient and better than the traditional methods of entering data into database

Time and resources are both saved for the office.

Smarter resource management takes place in the office.

OFFICE CHATBOT

Office ChatBot

We believe that a chatbot can help tremendously in the office automation space, save costs and save countless human hours that can be utilized for more productive work.

Our chatbot V, a polite, obedient and hilarious chatbot, can do the following functions :

1)It can greet users, handle basic conversational context, tell jokes, and is highly customizable for the needs of any organization to perform a wide range of HR operations seamlessly, and with minimal changes

2)The managers can check attendance and number of hours clocked-in of any day of any employee by simply typing in the name of the employee, thus saving costs and increasing productivity.

3)Also due to the chat-app interface, alerts are sent to the manager on a regular basis, notifying him of the other important statistics of the day like crowd count, crowd density in different locations, number of employees who clocked in late etc.

4)With reference to our lab, at any point in time, we can predict the presence of sir in the lab, by using an artificial neural network fed with the details of his presence for a time period of 2 weeks.

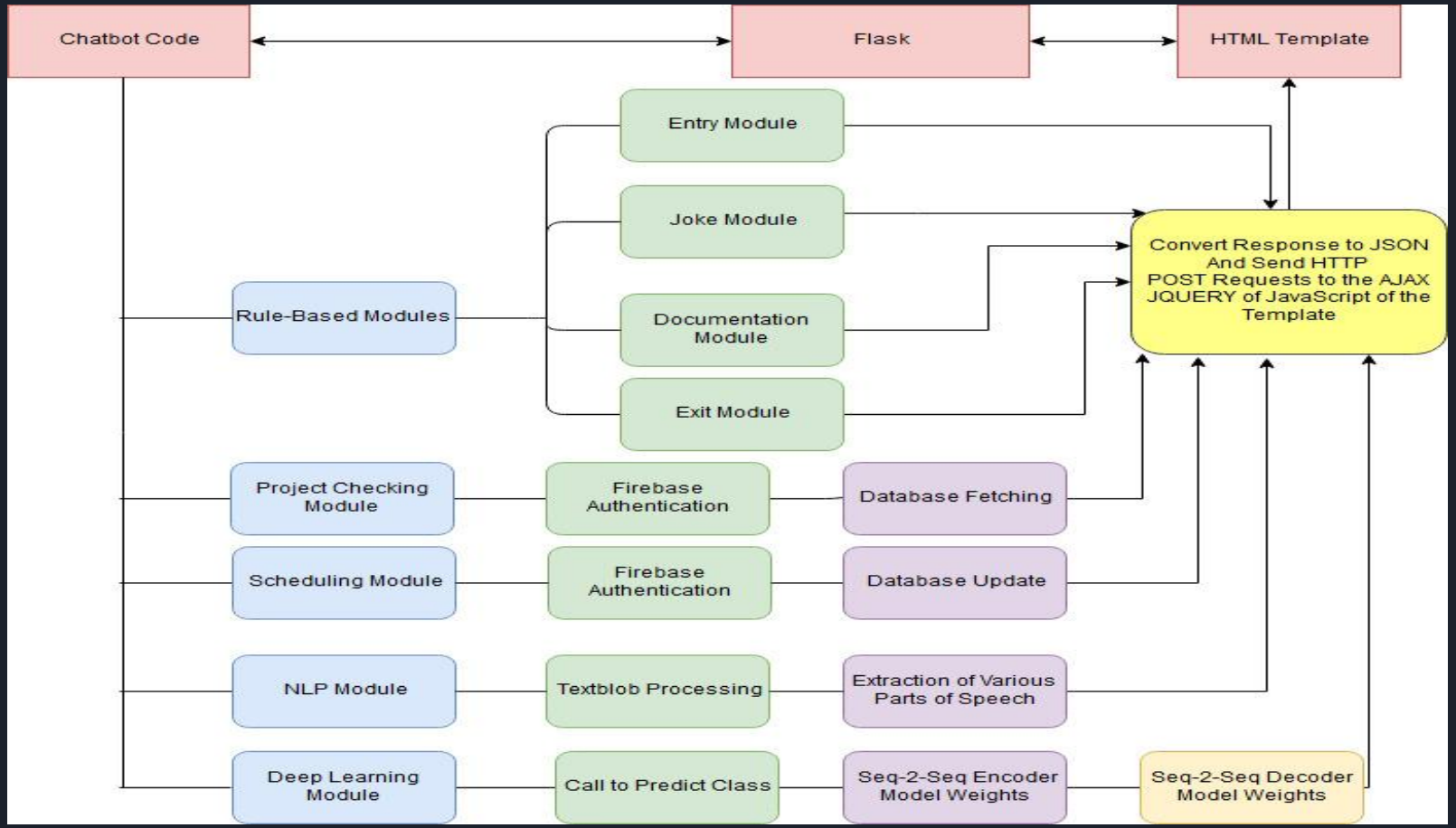
5) It can automate several low-level HR features for the employees like scheduling appointments, checking attendance and checking project status.

The chatbot presented in this project combines traditional rule-based chatbot models with advanced deep learning models.

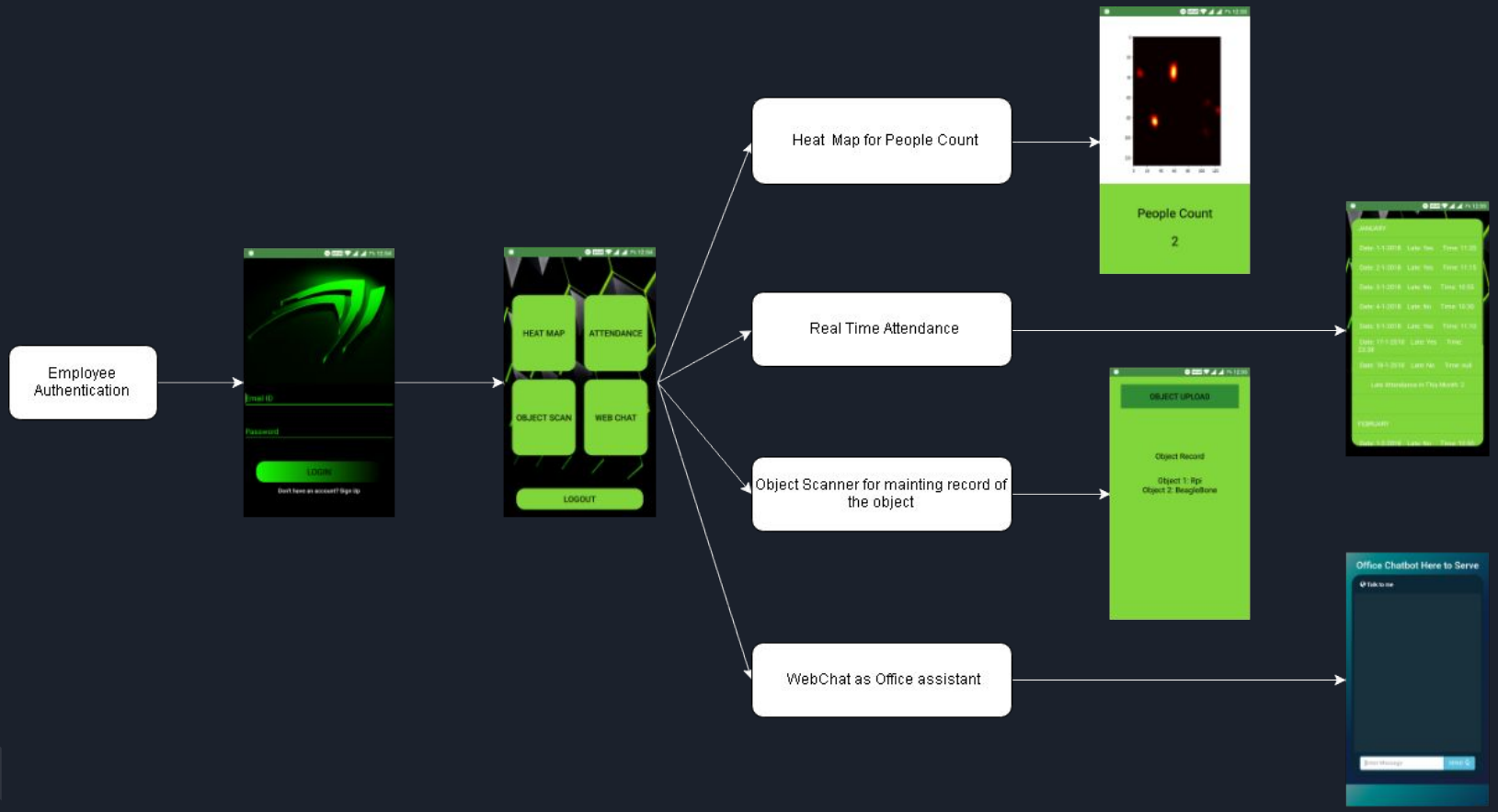
The deep-learning model used in this project is sequence-to-sequence model which consists of two RNNs - an encoder and a decoder which capture the semantic meaning of the input sentence and emit a decoded response based on its learnings.

Also used are rule-based conditionals and NLP algorithms, to seamlessly provide a natural feeling to the conversational flow.

The Chatbot FlowChart



Office Automation App Flowchart



INTEGRATION

Integration

The Chatbot, Heatmaps, Inventory Management System and Attendance Notification are all mounted on the android app that we created known as the Office Assistant App

All the Deep Learning models can run in parallel along the Jetson TX2 board.

Conclusion

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Due to the power of CUDA libraries, CudNN libraries and pascal architecture of jetson board ,even the complex models were deployed on a faster rate on continuous video stream .

Even in the max performance mode the power consumed was very much less by the Jetson TX2 board. The less power consumption is also what makes it suitable for our project as power conservation is the base of our idea