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Smart Security System Using IoT, Face Recognition and Processor to Processor Communication

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Abstract: In the present world the security of the home, banks, shops, etc., are the prime concerns. The traditional security such as Closed-Circuit Television (CCTV) cameras are very easy to break and lead to theft. And moreover, the installation cost of the security systems is costlier. To overcome these problems, we are presenting Internet of Things (IoT) based solution where we can setup a smart security system. In this paper, we are proposing the system with the help of face detection and face recognition algorithms to secure our home which gives us the facility of entire surveillance of our buildings remotely and take appropriate action if anything goes wrong. The Camera Serial Interface (CSI) is attached to the Raspberry PI which detects presence of person using Face detection and recognition algorithms. The multiple Raspberry PIs attached in different areas of our buildings are connected to the main Raspberry PI which acts as hub module. If the person is identified as unknown, the information is sent to Hub module which in turn sends the alert message and live video streaming to the user using an app which we developed.

Keywords: Face recognition, SSD algorithm, Mobile face net algorithm, Face detection, Native app development, IOT, Smart security system.

1. Introduction:

The home automation is being increasing rapidly in recent years due to considerable cost and simplicity through smartphones connectivity. In this proposed system, we will arm our home with multiple Raspberry Pis that communicate among themselves to accomplish a common goal. Because of lack of flexibility of commercially available systems, we bring in Raspberry Pis to the rescue [2].A mobile application is developed using react native to enable live streaming and options are given for the user such as alert police, lock door or ignore when an unknown trespasser enters the property [1] .

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The olden methods of automation systems had been practiced to every single device which was controlled remotely [6]. The situations such as not remembering to switch off the lights or fans before we go away didn't require to drive back to home because the most systems have far-off accessing abilities by just controlling that equipment on computer or smart gadgets in a few seconds [1]. The threats of incursion could be reduced by smart security system incorporated with the above discussed abilities t notify us instantly if something strange happens. Related work is illustrated in Section II, Methodology is proposed in section III, Section IV Conclusion.

2. Related works

2.1 3-DimensionalDeconvolutionalNetwork

In this paper, for demonstrating knowledge of high-measurements of video data, middle and low-level features were acquired from their proposed 3 Dimensional-Deconvolutional Network (3D-DN) [1]. In, under a scattered confinement, the video stills had been segmented into spatiotemporal in an unsupervised method [4]. It recognized human actions in multiple downstream machine learning goals that used by the high-level representation of the input data [4].

2.2 Dynamic Range-Doppler Trajectory & Radar-basedhumangait

The frequency-modulated continuous-wave (FMCW) was used to predict Doppler trajectory (DRDT) system [3]. The micro-doppler (m-d) for the torso and limbs stated that it improved their distinctive Joint Time–Frequency (JIF) features by employing the Short-Time Fourier Transforms (SFTFS) [1]. This produces very poor results in accuracy that can't be used for real time implementation. Our proposed work extracted improved features of torso and limbs and accomplished efficient feature fusion [6].

In the existing system, for demonstrating high-measurements of video data, the middle and low-level features were acquired from their proposed a new 3DDN [4]. The video stills had been segmented into spatiotemporal in an unsupervised method [2]. The disadvantage is that the 3DDN models gives low- and middle- level features of video clips. The number of hidden layers and feature maps in 3DDN would lead to improper results [1].

3. Proposed Work:

The home automation has been increasingly used in recent years due to the rapid usage of smartphones [3]. To save money, homeowners go with the basic packages for securing their homes. But culprits can find any unprotected entry point to home if you are only installing security system to front and backdoors [1]. Our interoperable system is involved with many Raspberry Pis that communicate among themselves to accomplish a common goal, four options are given to the user to alert user by predicting the presence of unknown person [4]. In this work, we use Python for programming our system because Raspberry Pi depends on Python as its primary

language [1]. Visual Studio (VS) was used platform for our work because VS is an integrated development environment that combines the source code editor with developer tooling [2]. The following shows the block diagram (Fig.1) and (Fig.2) shows the flowchart of our proposed system.

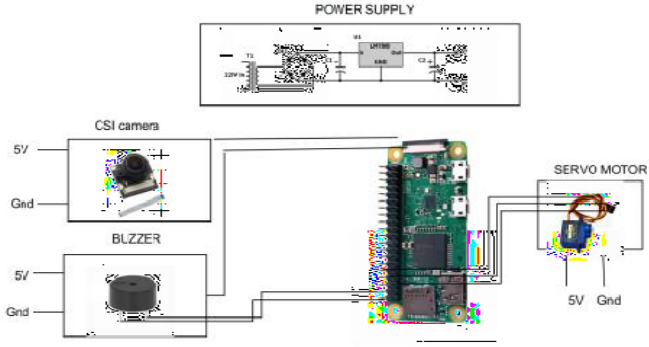

Figure 1. BlockDiagram

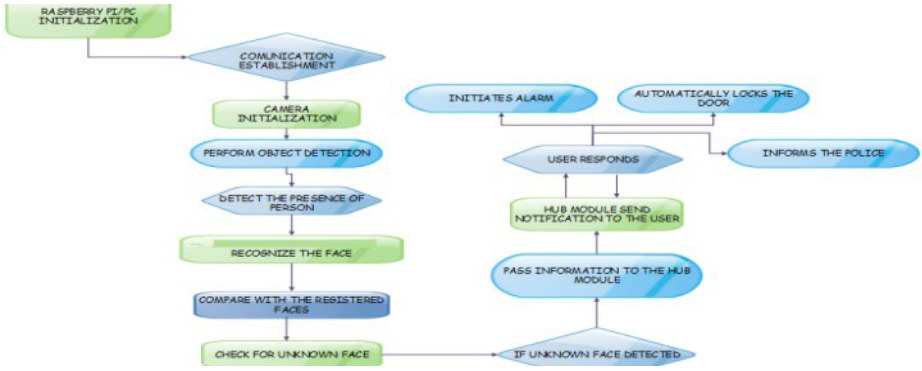

Figure 2. Flow Chart

3.1 Modules:

3.1.1 Object Detection Module

To detect objects, SSD (Single Shot MultiBox Detector) algorithm is used. It's faster than Faster Region Based Convolutional Neural Networks (RCNN). The framework map size was reduced by Convolutional Neural Network (CNN) network and increases deepness when it is going to the deeper layers. The larger recipient fields were covered by the deep layers that estimates to larger objects, while the smaller recipient fields were covered by the shallow layers which estimates to minor objects.

3.1.2 Face Detection Module

To detect the faces in low-power computing devices such as ARM, the "Ultra-Light-Fast-Generic-Face-Detector" has been used which is competent to both iOS and Android phones including personal computers (PCs). Detecting human faces in digital format is the beginning step. The input resoluteness of 320×240 is about only 90 to 109

MFlops in terms of model calculation. For working better in different application situations at 320x240 and 640x480 input propositions, it provides pre-instructing models using wider face instructions.

3.1.3 Face Recognition Module

For recognizing the face, we use mobile face net. In the wild text file(LFW) to label faces had 99.28 percent accuracy and in the AgeDB text file to distinguish the faces had 93.05 percent accuracy. It takes only few milli seconds to execute and give results on processors using in mobile phones and uses lower than a million frameworks. This accuracy was 2 times the actual speedup over MobileNetV2. For verifying face, it accomplished improved efficiency than the mobile CNNs. In the below table, the detailed structure is discussed,

Table1.Mobile Face Net architecture

Input	Operator	*t*	*c*	*n*	*s*
$112^2 \times 3$	conv3x3	-	64	1	2
$56^2 \times 64$	depthwise conv3x3	-	64	1	1
$56^2 \times 64$	bottleneck	2	64	5	2
$28^2 \times 64$	bottleneck	4	128	1	2
$14^2 \times 128$	bottleneck	2	128	6	1
$14^2 \times 128$	bottleneck	4	128	1	2
$7^2 \times 128$	bottleneck	2	128	2	1
$7^2 \times 128$	conv1x1	-	512	1	1
$7^2 \times 512$	linear GDConv7x7	-	512	1	1
$1^2 \times 512$	linear conv1x1	-	128	1	1

3.1.4 Image ZMQ For Pi To Pi Communication

Image ZMQ is used for transmitting the frames between the client and the server. ImageZMQ has been easy to transport images. Image ZMQ is used for video streaming with OpenCV. For performing the complicated image refining, the images have sent to the central Raspberry Pi via image ZMQ. The two different ZMQ messaging patterns such as REQUEST/REPEAT or PUBLISH/SUBSCRIBE are accepted by this method.

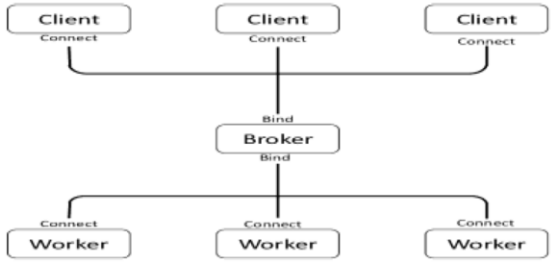

Figure 3. Overview architecture of ZMQ

3.1.5 MobileApp Module

React native has used for developing the mobile application. It was a framework that builds UI components to build the JavaScript code. To develop a mobile application, it includes a set of components for both iOS and Android platforms. It was good solution

for high-quality apps in a short time with the same performance and user-experience that native apps issue. In this, Android Studio was used for developing mobile app environment.

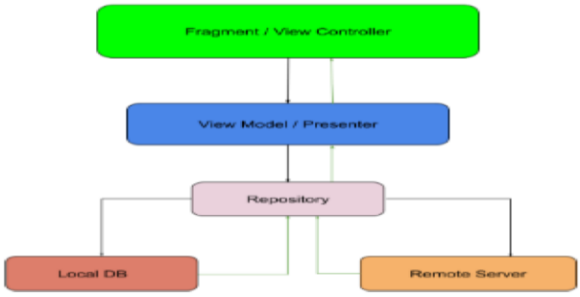

Figure.4. Mobile App Development

4. Results and discussions

Thus, security system with an application is developed based on the proposed algorithms. Initially, it detects the presence of a person in front of the camera. Then, the face is recognized based on the proposed algorithms and compared with the registered faces in data base. If the face is identified as unknown person, then the information containing the image of the unknown person is sent to the hub module which in turn sends the received information as alert message using the app we developed. If the user doesn't respond for a period of time, the alarm is initiated automatically and if the gate is not closed by the user, then using servo meter the gate is closed automatically.

5. Conclusion

Thus, this proposed system provides entire home surveillance using processor to processor communication. This proposed system is mainly used in home for security purpose which helps in saving people properties and money as well as automates the records which helps to punish the thief. It is accessible by the user from anywhere through the app we developed. This can also be implemented in banks, shops, etc...

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