CNN Image classifier on Raspberry pi 3B using pre trained data

Dr.HENRY

Student of Electronics and Communication,
Christu Jyoti Institute of Technology & Science,s
Warangal,India
rockswayxd@gmail.com

Abstract

Face recognition system is widely used for human   identification due to its capability to identify uniqueness in features just like finger print security but with a lesser scope   to replicate print and larger scope to make security better.   This paper presents the use of inception CNN model for face recognition   system on RasPi 3B and use of RasPi 3B's general purpose   pins as an input/output carrier to switch on/off magnetic   lock for door lock security system. The development is   implemented by interface built in python3,OpenCV and   Tensorflow with RasPi 3B's pins to relay to auto-switching   magnetic lock for door lock security system. The developed   system shows the is one example of process that improves the security application for these places. The advantage of using face recognition instead of other identification process like fingerprint identification is because it least likely to be faked and more secure [1]. The development of face recognition system for door lock control using Raspberry pi 3B is an example of security system for workplace or safe auto-switching mode transmission being   implemented via RasPi 3B and GPiO's on pretrained data. It was found RasPi   3B can successfully switch on and off the magnetic lock   when an authorized image database is identified.

1. Introduction

1.1 overview

The security has become an important issue and this is security systems have been using an important idea like recognition especially to access work places with confidential work in progress or places with content of value like databases of a company or safe. Face recognition is one example of process that improves the security application for these places[1]. The advantage of using face recognition instead of other identification process like fingerprint identification is because it least likely to be faked and more secure [2]. The development of face recognition system for door lock control using Raspberry pi 3B is an example of security system for workplace or safe. The process start by creating a new picture based on user face information. This picture is compared to the picture existing in database, and if the picture matches within a set features, access to the desire resource is granted the signal being sent through Raspberry Pi's GPiOs[3].Many methods can be

applied in face recognition system. One of them is using convolutional neural network. This idea behind the

1.2. Inception model

Inception module is to make this process easier and more efficient by explicitly factoring it into a series of operations that would independently look at cross-channel correlations and at spatial correlations[4]. More precisely, the typical Inception module first looks at cross channel correlations via a set of 1x1 convolutions, mapping the input data into 3 or 4 separate spaces that are smaller than the original input space, and then maps all correlations in these smaller 3D spaces, via regular 3x3 or 5x5 convolutions[4]Inception is implemented in python. As a standard computer, the Raspberry pi 3B also consists of CPU, ROM, I/O ports and timer. However, these also have a set of General purpose Input output pins (GPiOs). Raspberry Pi 3B has a built in General purpose input output hardware that allows direct communication with lock. This reduces need for serial communication unlike PC.
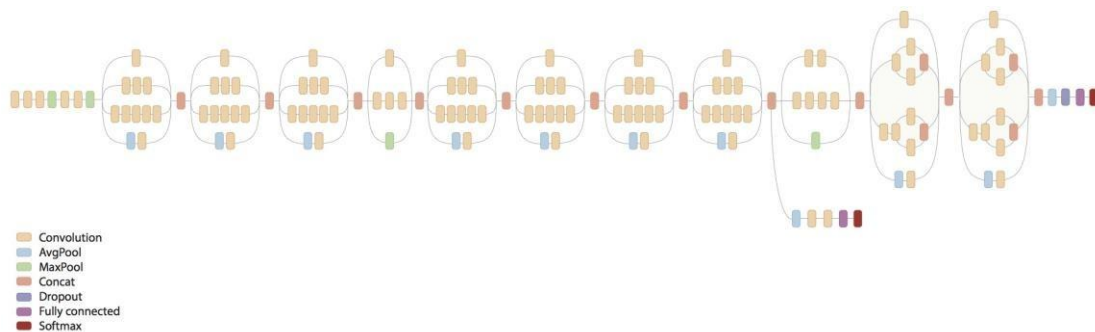

Convolution
AvgPool
MaxPool
Concat
Dropout
Fully connected
Softmax

Figure 1: flow chart of inception model

1.3. Significance

We have used pre trained data to use it for Raspberry Pi database that way we have reduced the computing stress of training data and once trained data can be used again and again as standard database. Instead Raspberry pi only takes the stress on verification process i.e changing into values and verifying it. However the raspberry pi is not such a powerful computer but it still has power to compute tensors and match it with old data of trained data

2. Rapsberry pi 3B

The Raspberry Pi 3B is with Single-board computer with wireless LAN and Bluetooth connectivity. The Raspberry Pi 3 is powered by a +5.1V micro USB supply and it also consists of 40 I/O pins [5]. The USB is connected to an external camera for capturing the picture for verification. Its CPU is 4× ARM Cortex-A53,

1.2
use
not
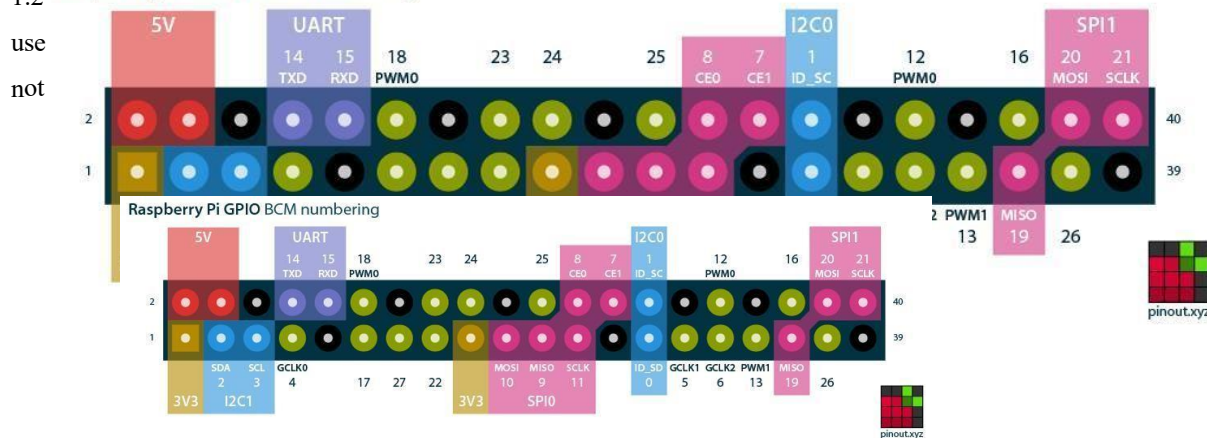
Figure   2: illustration of
Raspberry pi 3B GPIO's

3. Circuit Design

The magnetic lock unit is controlled by relay. The programming languages enables various functions of ports like digital I/O. When face is recognized the raspberry pi writes value to digital pin which operates relay. Relay is connected to magnetic lock through an 12v DC adapter. When the relay is in off position the lock is active and when face is recognized we see that relay turns off the lock and then the door is open for a period of 4-5 secs. If face is not recognized we observe no change is relay position i.e door remains locked. nitially the circuit was implemented only via GPIOs.A buzzer or light indicator was turned on every time the face was identified. Circuit initially need an power source to make it portable so it was powered by an mobile power bank.
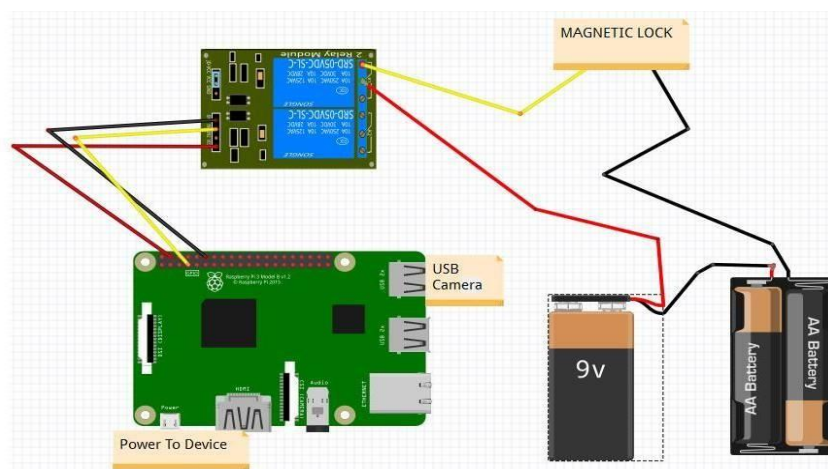

Figure 3: Illustrated Circuit design

4. Raspberry Pi 3B programming

4.1 Operating system of Raspberry Pi 3B

Raspberry Pi 3B is a small single-board computer that uses SD card as storage. It runs on Debian OS[7]. Debian has access to online repositories that contain over 51,000 packages making it the largest collection of software in the world. Debian officially contains only free software, but non-free software can be downloaded and installed from the Debian repositories[14]. *4.2 Python*

Python is an interpreter, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales.

4.3 Tensorflow

A Tensor Flow is an open-source software library for dataflow programming across various tasks. It is a symbolic math library, and is also used for machine learning applications like neural networks.[8]. TensorFlow was developed by the Google Brain team for internal Google use. It was released under the Apache 2.0 open source license on November 9, 2015.[9].

4.4 OpenCV

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision.[10]. OpenCV supports the deep learning frameworks TensorFlow, Torch/PyTorch and Caffe.[11].

4.5 Numpy

Numpy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.[12].

4. Issues

4.1 Compatibility

Tensorflow wasn't designed for raspberry pi 3B however there are repositories of tensor flow available for Raspberry Pi. Issues like processing speed or memory or the RAM are for its inability to upgrade hardware. An official tensor flow wasn't released for Raspberry Pi but yet there are some repositories available on GitHub.[13]. We can't expect to run or retrain the set because of its limits of Raspberry Pi 3B speed and so if we were to implement this system on Raspberry pi then it is slow and can't expect results within minutes. This delays process of locking or unlocking the door. We are not using cloud or api services too so no internet

is used and this system does not use tensorflow lite so it we build it from source. There some tweaked and optimized versions we can rely on installing

4.2 Solution

We tackle this issue by using the pre trained data .we pretrain the data on a computer and then we copy this retrained data and paste it onto the place in raspberry pi where results are stored. This way we use the tensor flow to cross check the image rather than use it retrains the data this reduces the strain on the Raspberry Pi. When the results of pre trained data are stored in correct location we can see that Raspberry Pi could recall the data and cross check it with sample image. Pre trained data has limited range but for a huge structure with a standard employees we have non changing data so it is trade-off between cost and computing which is solved by pre-trained data.

5. Results

Intially the magnetic lock is in on position and image is yet to be captured and verified
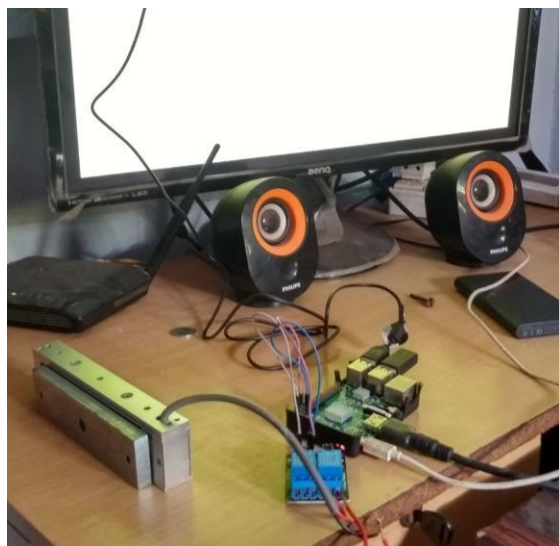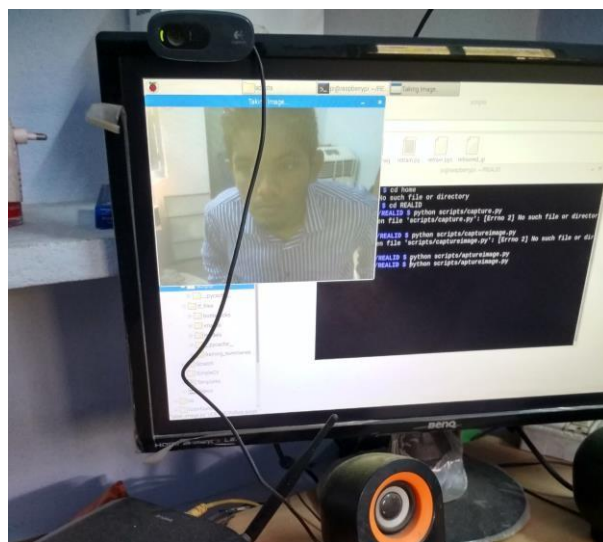

Figure 4 : the magnetic lock is in on position

Figure 5 : image to be verified is captured

Figure 6 : Post recognition the image is verified and door is unlocked

6. Observations

We also want to monitor the temperature of raspberry pi as we run the software, because the process is so heavy and memory consuming it may increase core temperature and the system might shutdown itself. Initially the temperature of the core was 51.2℃ and after running the program for 52 successive tries we observe the temperature of core was 56.6℃ that is the and increase of 5.4℃. This observation were taken under room temperature of roughly 41℃ and we only had aluminum heat sinks and no exhaust fan.

7. Conclusion

Face recognition based system has been developed and applied to the lock and is controlled using relay and all the processing work is done on Raspberry Pi 3B. This includes switching of relay and lock and as well as recognition of face. The system can be improved by developing GUI and automatic capturing of picture and verification by assigning a push button. This can be further be deployed in real time by connecting it to a

system as server or laptop as server and updating the pre trained data as per addition of new face entries. This has real time application with considerably less size and less power consumption because it only requires two power sources each of 12v which can be powered by car battery or cascading batteries. We can introduce pre trained data into the system where the computing power is limited by the processing power. We can also use these to make and deploy systems where there is cost related issues and also there are different image recognition models but the inception model has proven to achieves 93.3% top-5 accuracy on ImageNet and is much faster than VGG.

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