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Implementation of Number Plate Extraction for Security System using Raspberry Pi Processor

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***Abstract*— In real time applications the number plate of a vehicle is extracted in order to find the number as an authorized number or unauthorized number. The proposed application finds a better way to find the number plate of the vehicle using the advanced processor called Raspberry Pi which is a system on chip processor. Initially the authorized images are stored inside the processor then the comparison is performed. The occurrence of a vehicle is detected using the IR sensor, once if the vehicle is detected then the camera starts capturing the image, then the captured image is compared with predefined number stored inside the processor. In this project the DC(Direct Current)Motor is considered for gate operation. If the captured image is recognized as an authorized image then the gate will be opened and the number will be sent as a message to the android mobile, if it is not an authorized image the number is sent to the android mobile but the gate will not be opened**.

Keywords—Pre - Processing system; Gray Scale Conversion; Edge Detection; Raspberry Pi processor

1. INTRODUCTION

Number Plate Extraction of a system is the method in which the system automatically captures the image of the number plate of a vehicle and these details were verified using Raspberry Pi processor for authentication. The system also alerts the authorities when any unauthorized image of number plate was detected using buzzer alarm system. Raspberry Pi processor is considered as one of the advanced System On Chip(SOC)processor the study is made from the article [8]. The Edge detection algorithm is considered in the proposed system and the detailed study of edge detection is made from [7]. Canny Edge detection technique is considered where the range of the captured image can be calculated this is considered from the paper [1][6].The number plate details are fed inside the processor and the details are compared with the captured image the capturing techniques are considered from [2],[4]. The normal image is converted into gray scale image and this conversion is studied from [3],[5]. To perform this task, Raspberry Pi processor is programmed using embedded 'Linux'. The proposed method is a high-performance and parameterized Security System on a single Raspberry Pi Board, which has more flexibility, power, efficiency and stability.

2. PROPOSED SYSTEM

2.1 Pre-Processing System

The system follows the techniques like pre processing, gray scale conversion, canny edge detection to detect the captured image. The following block diagram represents the approach of proposed system.

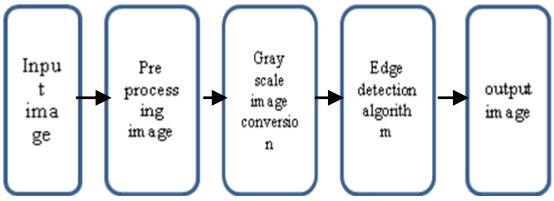

Fig 2:Original image

2.2 Gray Scale Conversion

The gray scale conversion considers a digital image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this type are also known as black and white, are composed exclusively of shades of gray, varying from black at the weakest intensity to the white at the strongest.Fig.2 represents the original image which is converted to gray scale image now the height and width values are obtained by making the normalized values to half, next the bounding boxes are created and the image is scaled.

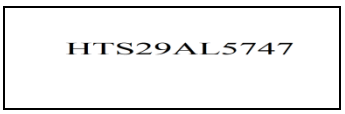

Fig 2:Original image

The gray scale is observed in Fig. 3 it would take every pixel of the picture to a number between 0 to 255 and the purpose of binarization is to take every pixel into the number of 0 to 255.To remove the tonal variations between red green and blue channels of input images and converting it into gray scale flatness to a single hue.

Fig 3: Gray-scale image

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2.3 Edge detection

Edge detection is the name for a set of mathematical methods which aims at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The point at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.

Types of edges

Generally edges are of three types:

Horizontal edges

vertical edges

Diagonal edges

Most of the shape information of an image is enclosed in edges, So first we detect these edges in an image and by using these filters and then by using these filters and then by enhancing those areas of image which contains edges, sharpness of the image which contains edges, sharpness of the image will increase and image will become clear.

2.4 Sobel operator

The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that corresponds to edges. Typically it is used to find the approximate absolute gradient magnitude at each point in an input gray scale image. When we apply this mask on the image it prominent vertical edges. It simply works like as first order derivative and calculates the difference of pixel intensities in an edge region. As the center column is of zero so it does not include the original values of an image but rather it calculates the difference of right and left pixel values around that edge. Also the center values of both the first and third column is 2 and -2 respectively. This give more weight age to the pixel values around the edge region. This increase the edge intensity and it become enhanced comparatively to the original image. Fig4 shows the vertical edge representing image.

Fig. 4: vertical edge image

Table represents the properties of sobel operator which are used to determine the edges of the captured image.

Table 1:Working of Sobel operator

1	2	1
0	0	0
1	2	1

Above mask is used to find edges in horizontal direction and it is because that zeros column is in horizontal direction. When you will convolve this mask onto an image it would prominent horizontal edges in the image. The only difference between it is that it have 2 and -2 as a center element of first and third row. This mask will prominent the horizontal edges in an image. It also works on the principle of above mask and calculates difference among the pixel intensities of a particular edge. As the center row of mask is consist of zeros so it does not include the original values of edge in the image but rather it calculate the difference of above and below pixel intensities of the particular edge. Thus increasing the sudden change of intensities and making the edge more visible. These masks are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one mask for each of the two perpendicular orientations. The masks can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation(Gx and Gy).These can be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by $|G|=\sqrt{Gx^2+Gy^2}$. Typically, an approximate magnitude is computed using $|G|=|Gx|+|Gy|$ which is much faster to compute. The angle of orientation of the edge (relative to the pixel grid) giving rise to the spatial gradient is given by $\theta=\arctan(Gy/Gx)$,Fig. 5 represents the finally observed filtered image.

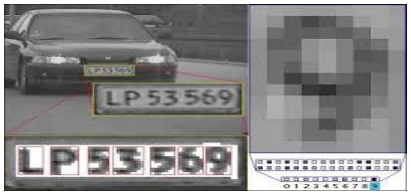

Fig. 5:Filtered image

3.HARDWARE PLATFORM

3.1 Raspberry Pi Processor

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi is manufactured through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Ego man. The hardware is the same across all manufacturers. The Raspberry Pi has a Broadcom BCM2835 System On a Chip (SOC), which includes an ARM1176JZF-S 700 MHz processor (The firmware includes a number of "Turbo" modes so that the user can attempt over clocking, up to 1 GHz, without affecting the warranty), Video-Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. Fig 6 represents the Raspberry Pi processor. In addition to the familiar USB(Universal Serial Bus), Ethernet and HDMI (High Definition Multimedia Interface) ports, the Raspberry-Pi offers lower-level interfaces intended to connect more directly with chips and subsystem modules. These GPIO (general purpose I/O) signals on the 2×13 header pins.CSI (Camera Serial Interface) can be used to connect the 5 MP(Mega Pixel) camera available. The

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Model A has 256MB RAM, one USB port and no Ethernet(network connection). The Model B has 512MB RAM,2USB ports and an Ethernet port. For the proposed application Model B processor is considered.

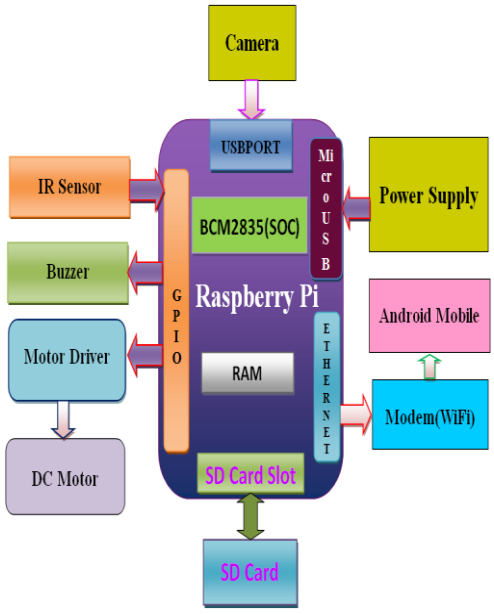

Fig. 6: Raspberry Pi processor

3.2 Broadcom BCM 2835 (SOC)

The processor at the heart of the Raspberry Pi system is a Broadcom BCM2835 System-On-Chip (SOC) multimedia processor. This means that the vast majority of the system's components, including its central and graphics processing units along with the audio and communications hardware are built onto that single component hidden beneath the 256 MB memory chip at the centre of the board (see Figure 2.2).It's not just this SOC design that makes the BCM2835 different to the processor found in the desktop or laptop, however, it also uses a different Instruction Set Architecture (ISA), known as ARM.

3.3 General purpose input output pins(GPIO)

There are 26 pins grouped in two rows of 13, and these collectively called the general purpose input output header or GPIO for short. These are a mix of four power pins, five grouped pins and 17 data pins. When working with the GPIO pins, always do this while the Pi is unplugged, as any accident by connecting (or shorting) 2 pins together can cause damage to the Raspberry Pi. These interfaces are not "plug and play" and require care to avoid miss-wiring. The GPIO pins including a UART an i2c bus, SPI bus with two chip selects, i2s audio,3V3, 5v and ground. The maximum number of GPIO's can theoretically be indefinitely expanded by making use of the i2c or SPI bus. Fig 7 represents the Raspberry Pi processor architecture with pin description.

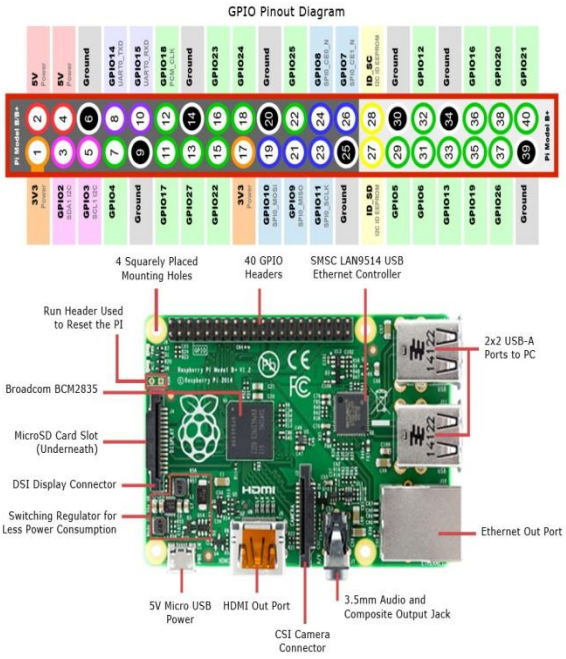

Fig 7: Raspberry PI processor architecture

3.4 Camera

The algorithm proposed in this paper is designed to recognize number plates of vehicles automatically. Input of the system is the image of a vehicle captured by the camera. Fig 8 represents the camera module which is used to capture the images. The captured image takes from 4-5 meters away is processed through the number plate extractor with giving its output to pre processing part. And finally edge detection part recognizes the characters giving the result as number plate. The camera module is capable up of taking photos up to 5 megapixels (5MP)(2592 * 1944 pixels) and can record video at resolutions up to 1080 p 30 (1920 *1080 *30 fps). There are three command line applications provided for stills, video and stills output uncompressed.

Fig 8:Raspberry pi camera module

3.5 DC(Direct current)Motor

A dc motor uses electrical energy to produce mechanical energy, very typically interaction of magnetic fields and current carrying conductors. Here the dc motor is used for gate operation. This is a very useful chip, it can actually control two motors independently, the pins on right side of the chip are for controlling a second motor.

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3.6 DC Motor Driver

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. Fig 9 shows the working of DC motor

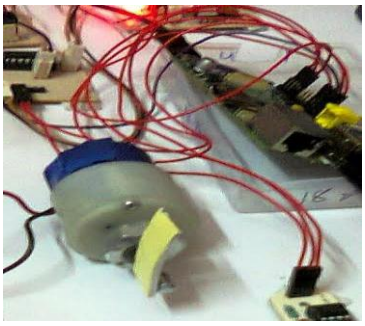

Fig. 9:working of DC Motor

3.7 Ethernet port

The Model B and Model B+ version of the raspberry pi device have built in 10/100 wired Ethernet. This is attached via the USB 2.0 bus to the processor. Fig 10 shows the Ethernet port of Raspberry pi processor.

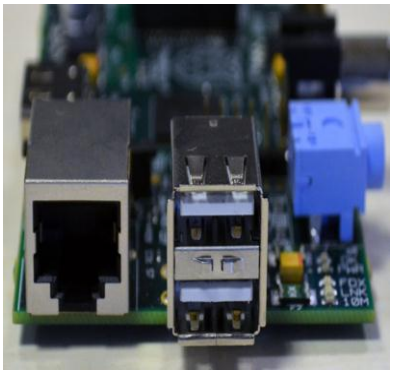

Fig 10: Ethernet Port ***S***

SD Card slot

The Raspberry Pi will not start without properly formatted SD card, containing the boot loader and a suitable operating system. Many problems with booting the Pi are a result of an improperly formatted or corrupted card. The Pi is inserted properly the power must be shut down before powering on the Pi. The content of the SD card is known as its file system, and is split into multiple sections each with a particular purpose. Although it's not necessary to understand what each section does in order to use the Raspberry Pi, it can be helpful background knowledge should anything go wrong. Installing new software onto the Pi is simple. Fig 11 shows the output during the SD card installation. The Debian distribution includes a tool called apt, which is a powerful package manager. Packages are what Linux calls a piece of software, or a collection of different pieces of software designed to work together. The Linux terminal shown in the figure shows different commands that are used during the execution of the application.

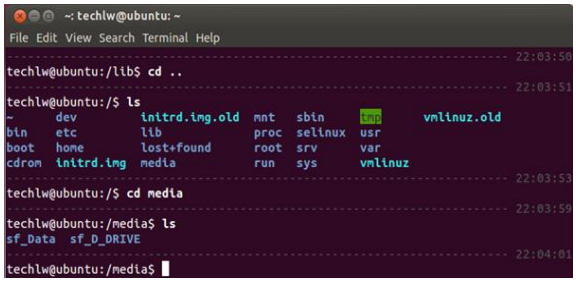

Fig. 11:SD card setup

3.8 IR SENSOR

To detect the occurrence of any vehicle the IR sensor is used and in order to detect the ON and OFF conditions of the raspberry pi processor buzzer is connected to the raspberry pi processor this is shown in the Fig 12.

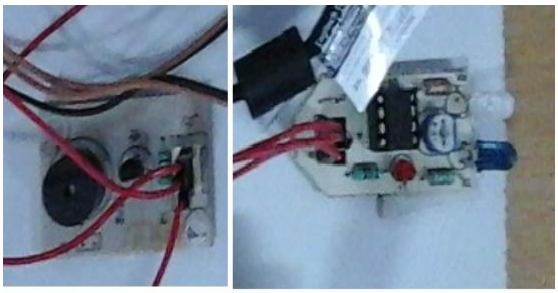

Fig. 12:Working of IR sensor

3.9 NOOBS

To get started with the Raspberry Pi an operating system is needed. NOOBS(Net Out Of The Box Software)is an easy operating system install manager for the Raspberry Pi. When booting up for first time there a menu will be prompting to install one of several operating systems into free space on the card. After installing an operating system, Pi will boot as normal. Fig 13 represents the image observed while installing. However, NOOBS allows to switch to a different operating system, or overwrite a corrupted card with a fresh install of the current one.The window appears as shown in the Fig 14 after completion of the software installation.

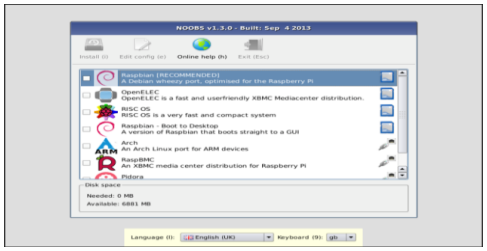

Fig. 13:NOOBS image

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Fig. 14: Software installation

RESULTS

After the design process completed, the state of hardware platform which contains interfacing of camera, DC motor, buzzer, Wi-Fi modem and Android mobile is shown in Fig 15. If it is an authorized image gate will be opened and number will be displayed in the android mobile which is represented in Fig 17 and if unauthorized image then only the number will be displayed. The images are received using the router to the android mobile and the images are stored in SD card. The following Fig 16 represents the results obtained if the image is not in still state and if it is an unauthorized image.

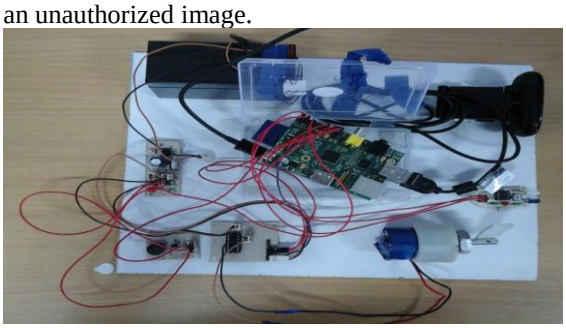

Fig. 15: Final setup

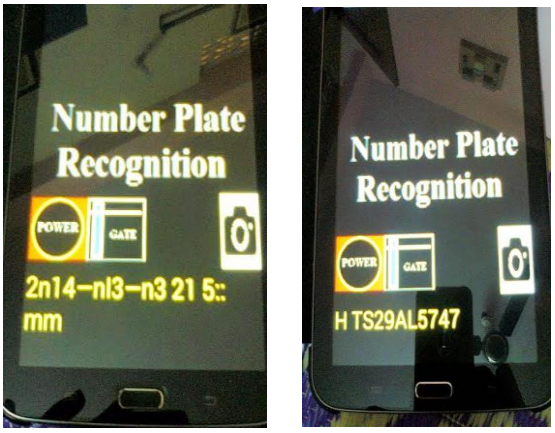

Fig. 16:Unauthorized image

Fig. 17:Authorized Filtered image

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