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Raspberry Pi Based Control System Using Image Processing



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Abstract:

This development deals with the latest technology called the raspberry pi based control system using image processing. It's a portable interface that arguments the physical world around us with the digital information. It's just born concept which allows user to connect with the real world seamlessly. The technology with which a system could exist to recognize and percept real world objects and react as desired. Raspberry pi based control system using image processing technology bridges the gap between the physical world and the digital world, bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via image processing.We are making use of standalone ARM11 processor for image processing. A USB camera is used with ARM11 processor to enable the project with machine vision. This project can be used to control the high voltages home appliances such as lamp, fan etc. using machine vision. User needs to show the images drawn on a paper and show it the camera. Based on the predefined logic the electrical devices will be turned ON or OFF.

Keywords:

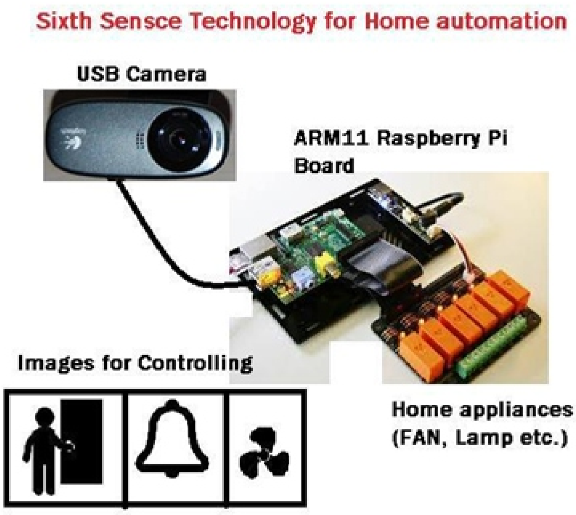
Raspberrypi Board with regulated power supply, Relay, Hard Disk (SD card), Camera.

1.Introduction:

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. The controlling device of the whole system is a Raspberry Pi processor. Bluetooth module, 4-Relays board are interfaced to the ARM1176JZF-S 700 MHz processor Raspberry Pi. The data received by the Bluetooth module from Android smart phone is fed as input to the ARM1176JZF-S 700 MHz processor. The processor acts accordingly on the Relays to switch connected electrical appliances. In achieving the task the controller is loaded with a program written using Embedded Linux programming language.

2.Design and Implementation:

In this block diagram the development and design aspect of independent modules are considered.



We are making use of advanced ARM11 Microprocessor with Embedded Linux RTOS (1GB RAM, 1GHz Processor speed).

1.Power on the ARM11 Board
2.Initialize the USB camera module.
3.Camera starts capturing the images in front of it at the rate one second.

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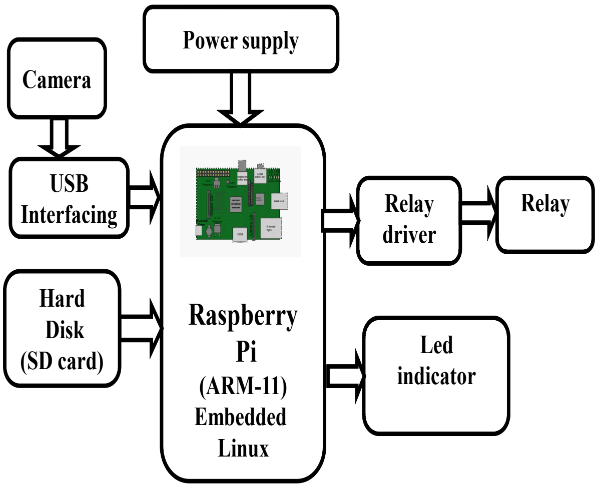
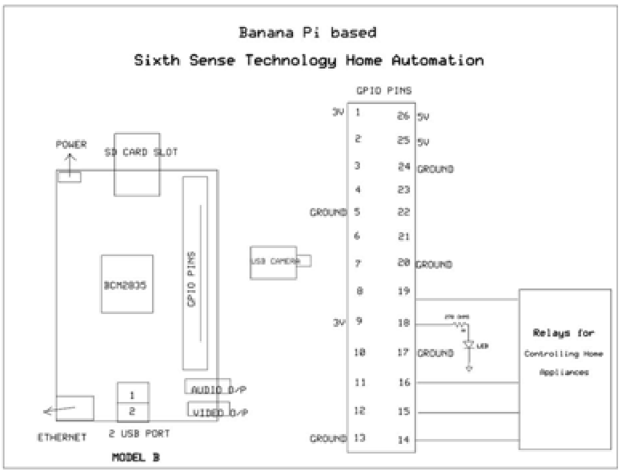
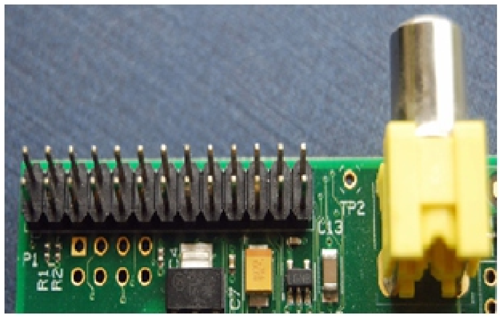
4.Captured images are compared with predefined image database.
5.If the image matches with predefined database images then the respective action will be taken.
6.We are making use of four images for this purpose.
7.These four images are used to control 4 different relays (loads)
8.When the first image matches then the first relay will be turned ON. When the second matches then the second relay will be turned ON. And so on…..
9.The device will be in ON position as long as the images are in front of the camera. If the images are taken off then the relays will be turned OFF.
Relays are powered with 5V DC power supply. Controlled by digital IO of ARM11 processor.



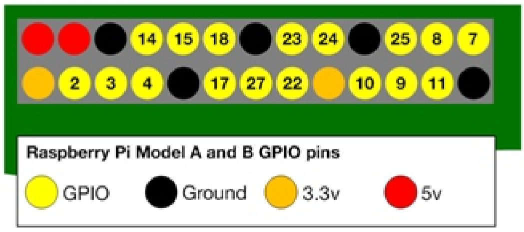


GPIO-Raspberry pi model A and B Specifications:

One powerful feature of the Raspberry Pi is the row of GPIO (general purpose input/output) pins along the edge of the board, next to the yellow video out socket.



These pins are a physical interface between the Pi and the outside world. At the simplest level, you can think of them as switches that you can turn on or off (input) or that the Pi can turn on or off (output). Seventeen of the 26 pins are GPIO pins; the others are power or ground pins.



	Model A	Model B
Target price:	US$ 25	US$ 35
SoC:[8]	Broadcom BCM2835 (CPU, GPU, DSP, SDRAM, and single USB port)	
CPU:	700 MHz ARM1176JZF-S core (ARM11 family, ARMv6 instruction set)	
GPU:	Broadcom Video Core IV @ 250 MHz OpenGL ES 2.0 (24 GFLOPS) MPEG-2 and VC-1 (with license[74]), 1080p30 h.264/MPEG-4 AVC high-profile decoder and encoder[3]	
Memory (SDRAM):	256 MB (shared with GPU)	512 MB (shared with GPU) as of 15 October 2012
USB 2.0 ports:	1 (direct from BCM2835 chip)	2 (via the built in integrated 3-port USB hub)
Video input:	A CSI input connector allows for the connection of a RPF designed camera module	
Video outputs:	Composite RCA (PAL and NTSC), HDMI (rev 1.3 & 1.4), raw LCD Panels via DSI 14 HDMI resolutions from 640×350 to 1920×1200 plus various PAL and NTSC standards.	
Audio outputs:	3.5 mm jack, HDMI, and, as of revision 2 boards, I²S audio (also potentially for audio input)	
Onboard storage:	SD / MMC / SDIO card slot (3.3V card power support only)	
Onboard network:	None	10/100 Ethernet (8P8C) USB adapter on the third port of the USB hub
Low-level peripherals:	8 × GPIO, UART, I²C bus, SPI bus with two chip selects, I²S audio +3.3 V, +5 V, ground	
Power ratings:	300 mA (1.5 W)	700 mA (3.5 W)
Power source:	5 volt via Micro USB or GPIO header	
Size:	85.60 × 53.98 mm (3.370 × 2.125 in)	

Weight:	45 g (1.6 oz)
Operating systems:	Arch Linux ARM, Debian GNU/Linux, Fedora, FreeBSD, Net BSD, Plan 9, Raspbian OS, RISC OS, Slackware Linux

3.Analysis:

The Analysis of Raspberry pi based control system using image processing by using this code we can design the project.

```
#include <stdio.h>
#include <string.h>
#incldue <gpio.h> //for device operation IO
#include <camera.h> //For camera control

void main()
{
        gpio_init();

        JPEG_Image data, ref_data[4]; //for storing 4 ref-
erence images

        //IO Port Initialisation

        gpio_set_output(29); //Relay 1

        gpio_set_output(31); //Relay 2

        gpio_set_output(33); //Relay 3

        gpio_set_output(35); //Relay 4

        ref_data = load_reference_images("lamp.
jpg","bell.jpg","door.jpg","fan.jpg");

        raspicam::RaspiCam Camera; //Cmaera object
Variable

        Camera.grab();  //capture camera

        while(true)
        {

                Camera.grab();  //capture camera

                data = Camera.retrieve (
raspicam::RASPICAM_FORMAT_RGB ); //get camera
image

                if(OpenCV.imagediff(data,ref_data[0]))
//compare two images (lamp.jpg)
                {
                        gpio_set_high(29); //Relay1 ON
                }
                if(OpenCV.imagediff(data,ref_data[1]))
//compare two images (bell.jpg)
                {
                        gpio_set_high(31); //Relay2 ON
                }
                if(OpenCV.imagediff(data,ref_data[2]))
//compare two images (arrowRIGHT)
                {
                        gpio_set_high(33); //Relay3 ON
                }
                if(OpenCV.imagediff(data,ref_data[3]))
//compare two images (arrowLEFT)
                {
                        gpio_set_high(35); //Relay4 ON
                }
                else
                {
                        gpio_set_high(29);      //Relay1
OFF
                        gpio_set_high(31);      //Relay2
OFF
                        gpio_set_high(33);      //Relay3
OFF
                        gpio_set_high(35);      //Relay4
OFF
                }
        }
```

Advantages:

1.Highly efficient and user friendly design.
2.Easy to operate.
3.Low power consumption.
4.Home automation control using image based technology
5.Efficient design.

Disadvantages:

1.Capturing of images with the help of camera to ARM-11 processor is highly sensitive
2.It will supports only for limited distance.
Applications:
1.We can use this to control home and industrial appliances in real time.

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4.Conclusion:

The Raspberry pi based control system using image processing is mainly intended to design for controlling the home appliances.The controlling device of the whole system is a Raspberry Pi processor. Bluetooth module, 4-Relays board are interfaced to the ARM1176JZF-S 700 MHz processor Raspberry Pi. The data received by the usb camera is fed as input to the ARM1176JZF-S 700 MHz processor. The processor acts accordingly on the Relays to switch connected electrical appliances. In achieving the task the controller is loaded with a program written using Embedded Linux programming language.This development can be extended using high efficiency GSM module using which the devices can be controlled from unlimited distance. The GSM module gives the SMS messages of devices status intimation through SMS. And with the help of GPS module can we can know the location of the devices operated were detected in case of emergencies.

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