International Journal of Control and Automation
Vol.8, No.11 (2015), pp.407-414
http://dx.doi.org/10.14257/ijca.2015.8.11.37

High Performance Surveillance and Operating Robot with Raspberry Pi

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Abstract

In this work, we are harnessing the benefits available in Raspberry pi in order to make a robot vehicle that is fully controlled by the raspberry pi. Every month there is a new technology launched in some or the other part of the world, by this statement we can estimate how fast the world is growing in field of science and technology. If we study the current era of technology, the upcoming trend we can see is that of the nanotechnology, robotics, artificial intelligence, internet of things, and automation. One of the technologies that we are studying is the coming up of mini CPUs, or we can say the Raspberry pi. The ARM architecture is what the raspberry pi is based on.

Keywords: *Raspberry Pi, Ulterasonic Sensor, Pi Cam*

1. Introduction

The Raspberry Pi [3] is a small handy CPU that can be plugged to your TV or computer monitor and can be controlled using keyboard and mouse. It is capable of performing every function that a normal computer does, say it writing a document, or surfing the net or playing games. Currently it is been used for making unique kinds of projects, mainly in the robotics field. Our main purpose of studying raspberry pi was to explore ourselves in the field of IOTs (Internet of Things). The project is devided into different modules which will be discussed soon. The first task was to set up Raspbian. Raspberry Pi is Linux based.

Figure 1. Board of Raspberry Pi Model B [1]

ISSN: 2005-4297 IJCA

Linux [4] is an operating system. The code is written on the leafpad and executed on the LX terminal through some commands. The desired circuit is made on a PCB or breadboard. The required connections or input or output connections are made to the GPIO pins of the pi. And by making those pins active we can obtain the required output. Raspberry pi is a very captivating concept to work upon, where we learn new concepts. Once the techniques are clear, practical implementations become easier. For actual implementation using Linux platform, we are using understanding the Linux kernel [4]. We are using user guide for raspberry pi. [5] for coding and implementation part. Before, starting our implementation, we study Bluetooth communication using a touchscreen interface with the Raspberry Pi [6] and getting started with raspberry pi [7].

2. Description of Raspberry PI

The model we have studied is model B, the features that make it different from the previous models are the increase in RAM, ROM, number of GPIO pins; additional ports for mouse and keyboard connectivity and one Ethernet port. The raspberry pi is based on Linux software and Python programming, so before starting, one needs to have thorough knowledge about Linux and Python.

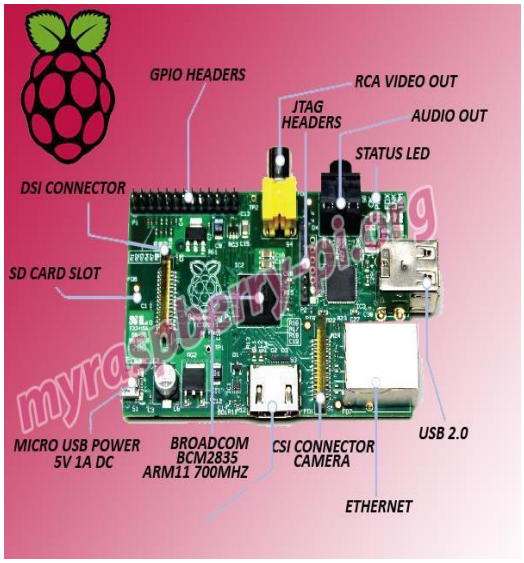

Figure 2. Ports on Raspberry Pi [2]

We further classify components of raspberry pie into 10 modules. These are shown in Figure 3.

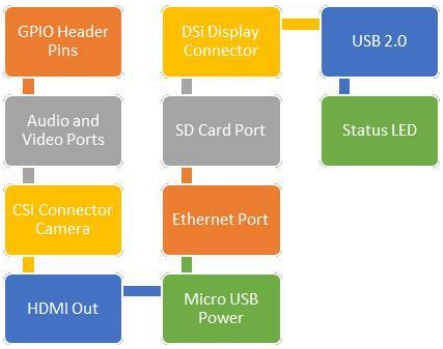

Figure 3. Different Interface Available on Raspberry Pi

2.1. *GPIO Header pins*

The GPIO pins acts as an interface between the pi and the outside world. You can perform any kind of function using these GPIO pins. There are 26 GPIO pins in the B model, and 40 GPIO pins in the higher models.

Table 1. Configuration of GPIO Pins

3 V	1	2	5V
GPIO2	3	4	5V
GPIO3	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	1	GPIO18

GPIO27	13	21	GND
GPIO22	15	16	GPIO23
3V	17	18	GPIO24
GPIO10	19	20	GND
GPIO9	21	22	GPIO25
GPIO11	23	24	GPIO8
GND	25	26	GPIO7

There are 6 input output pins, two pins for transmitting and receiving and 3 serial ports for analog data input(as shown in fig.4). The GPIO pins read only two logics, logic high(1) or logic low(0). Most part of the python code is usually a series of high or low input commands. Below is an example of Python code for blinking an LED. For that we just open the leafpad and write the below code and save it as blinky.py as shown in Figure 4 and its result in Figure 5.

blinky.py

```
Import time

Import RPi.GPIO as GPIO

LED=22
GPIO.setmode(GPIO.BOARD)
GPIO.setmode(GPIO.OUT)
GPIO.setmode(GPIO.OUT)

while True:
GPIO.output(LED,
GPIO.1)
Time.sleep(0.5)
GPIO.output(LED,
GPIO.0)
Time.sleep(0.5)
```

Figure 4. Python Code for Blinking an LED

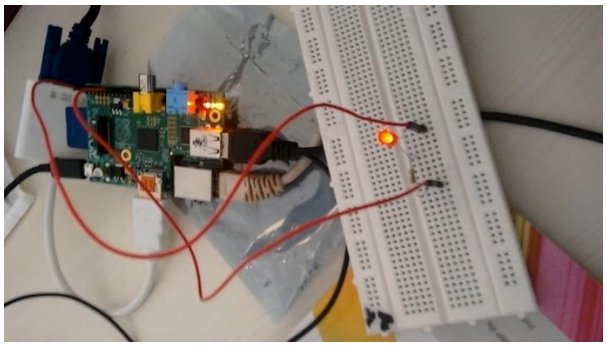

Figure 5. Blinking an LED

Open the LX terminal, write python blinky.py and press enter.

The output will be blinking of the LED light with an interval of 0.5 seconds.

2.2. Audio and Video Port

Audio and Video port is used for audio and visual purposes.

2.3. CSI Connector Camera

Only the raspberry pi camera called the PiCam can be connected through this port. We can also use webcams but there is a different procedure for this.

2.4. HDMI Out

The HDMI port is used to connect the raspberry pi to the monitor.

2.5 Micro USB Power

Power is supplied using the micro USB power supply port. Power supply should not be more than or less than 5 Volts.

2.6. Ethernet Port

Port for the LAN wire connection, provides internet connectivity to the pi.

2.7. SD Card Port

SD card is required to install software i.e. NOOBS (New Out Of the Box Software). If we are using raspberry pi first time, NOOBS is the easiest way to set up raspberry pi easily. There is no need for network access, and no need of downloading any special imaging software. Just download the NOOBS zip file from the official website of raspberry pi, and unpack it onto 4GB (or larger) SD card. During the first boot up process, a menu prompts install one of several operating systems into the free space on the card. We can boot the Pi with a regular operating system like Raspbian, or with a media-center specific OS like RaspBMC, it is all your choice.

2.8. DSI Display Connector

For displaying characters on LCD.

2.9. USB 2.0

For connecting with mouse or keyboard.

2.10 Status LED

Labels	LED	Means
ACT	D5 (Green)	SD Card Access
PWR	D6 (Red)	3.3 V Power is present
FDX	D7 (Green)	Full Duplex (LAN) connected
LNK	D8(Green)	Link/Activity (LAN)
100	D9(Yellow)	100Mbit (LAN) connected

Figure 6. STATUS LED of Raspberry Pi

2.11 Broadcom BCM2835 ARM11 700MHz

Raspberry pi based on ARM architecture. BCM2835 is a cost efficient, high definition processor. ARM11 is a 32-bit RISC ARM processor core.

3. Boot Process

Once the connections are done (refer Figure 3 for making connections), switch on the pi, if the NOOBS is present in the SD card, the boot process begins, the NOOBS is installed and after that a login prompt appears. The default login for Raspbian is username pi and password is raspberry. This is a security feature in Linux. After successful log in, the command line prompts as shown in Figure 7.

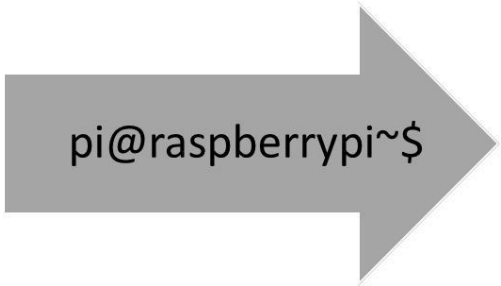

Figure 7. Raspberry Pi Command Prompt

To load the graphical user interface, type startx and press Enter on the keyboard. This is how the screen looks after the boot process and login process.

Figure 8. Screen of the Monitor after Installing Raspbian

MOTOR DRIVING AND CONTROLLING DIRECTIONS USING KEYBOARD

Following is a PYTHON code for motor driving and controlling directions using keyboard.

```
Import time

Import RPi.GPIO as GPIO
GPIO.setmode(GPIO.BOARD)
GPIO.setup(22, GPIO.OUT)

GPIO.setup(24, GPIO.OUT)
GPIO.setup(16, GPIO.OUT)
GPIO.setup(18, GPIO.OUT)

GPIO.output(22, GPIO.HIGH)
 GPIO.output(24, GPIO.HIGH)
GPIO.output(16, GPIO.HIGH)

 GPIO.output(18, GPIO.HIGH)

while
true:
x=raw
_input
();
y=int(
x)
```

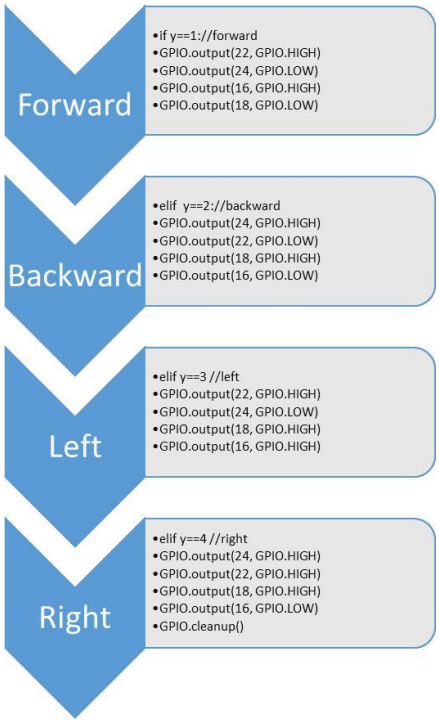

Figure 9. Code to Control Direction Using Keyboard

We are using components like LM293D [5], servo motor, male female connectors, battery, and robot chassis. In order to make the connections, we are referring LM293d datasheet. After that, we connect one input of motor to pin number 22, 24, 16 and 18. And finally, we make the chassis; place the batteries, motor driving IC, raspberry pi WIFI dongle and webcam on it

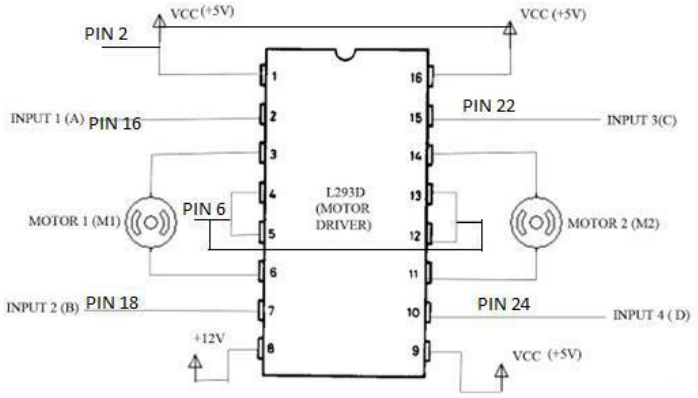

Figure 10. Connections of LM293D to Raspberry Pi

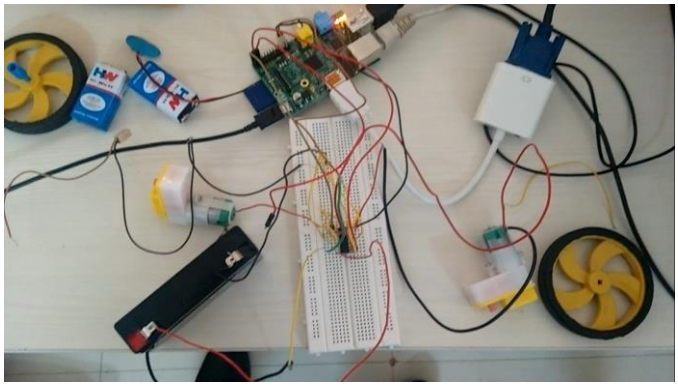

Figure 11. Motors Connected to the Motor Driving Circuit and LM293D

The screen as shown in Figure 11 appears after the boot process. For writing a python code, right click on the screen and open the leafpad, now write the code in the leafpad and save the file in .py format. Now open the LX terminal. Write python filename.py and press enter. Output: If keyboard input is 1, the motor moves in the clockwise direction. If the keyboard input is 2, it moves in the anticlockwise direction. After this wifi interfacing is done.

4. WIFI Interfacing

Connect the wifi dongle and the pi cam to the raspberry pi. The wifi dongle is connected to the raspberry pi.an application that is preinstalled in rasbian named wiconfig is then opened. The pi is then connected to the router and some command are executed (ifconfig). After the application is installed an IP is obtained in output. That IP address is then written on the browser of the monitor run by raspberry pi. The web cam attached on the pi turns on and we are able to see the surroundings of the bot using pi cam. The movement of the robot car is controlled through the keyboard.

5. Economical Feasibility

Overall Cost of the project is less than 100 USD. That is the another USP of our work and is in buying capacity of any students.

COMPONENTS	COUNT	COST
Raspberry Pi Model B	1	Rs. 4000
Wifi Dongal	1	Rs. 2000
120rpm gear motors	2	Rs. 200
Motor driving circuit	1	Rs. 40
Total		Rs 6240

6. Conclusion

After working this much on raspberry pi, many conclusions were raised, like the raspberry pi is highly sensitive, one small mistake in the connections can damage the raspberry pi, its adverse effects re seen on the GPIO pins, like the pins not functioning properly or some of the pins not working at all. So before starting with the pi, it is important to have a great knowledge about the pi.

7. Future Scope

After the B model, various new models of Raspberry pi have been launched, each model having its own specifications. Raspberry pi is a very great field to work upon, especially for those who are more in to robotics and embedded systems. It can be a great learning for them. And innovations can be done using this technology. In future, we are also planning to commercialize this project with embedded design startup due to its market appeal and minimum cost (less than 100 USD). This goal is also in accordance with government of India

Initiative called “Startup India and Standup India”.

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