Designing of Efficient Security System for Domestic and Defence Purposes

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ABSTRACT: The paper proposes a Raspberry Pi robot which has the capabilities of being used in our households to provide better security and in defense for enhanced communication and reducing the number of causalities on the war field. It can serve multiple purposes like surveillance, target location and intruder detection. The robotic locomotion and image acquisition is based on the hardware chosen according to the purpose and the algorithms fed to the controller.

KEYWORDS: Raspberry Pi, surveillance, locomotion, causalities

I. INTRODUCTION

Virtually every CCTV camera in the market requires at least one cable to the camera's location, whereas the Raspi has on onboard power supply. Also, the most commonly used radio band for transmitting their signals is not suitable for long signal transmissions. The functional possibilities of the Raspberry pi, being an IOT device, are limited only by our usage. Hence we intend to replace soldiers by Robots which will be controlled externally from a distant location by trained army men themselves. This will eliminate the chance of death of our brave soldiers. A recent study estimated that by 2020, 50 billion devices will be connected to the internet, making the Raspi an important contender to be used with various "Smart House" devices. So a similar approach can be made in households or other places of high security requirements like banks and datacenters by using a robot of similar kind with different added features. For the defense purpose, we intend to use a Hexapod Robot, which is more stable and flexible when compared to the other designs, taking the variety of terrains into consideration. The Hexapod has six legs, eliminating the need for a balancing mechanism and travelling faster across different kinds of surfaces, when compared to the conventional quadrapod or other models. Its heavy legs with powerful microservomotors give it good payload capabilities. It uses an Arduino Uno microcontroller for locomotion and Raspberry Pi B+ Board for enhanced image processing and other security needs.

For domestic purposes, we use only the Raspberry Pi B+ Board as it is capable of handling these minor security measures without much of locomotion required. We intend to use the normal 4 wheel chassis with torque motors and a high resolution camera for image acquisition.
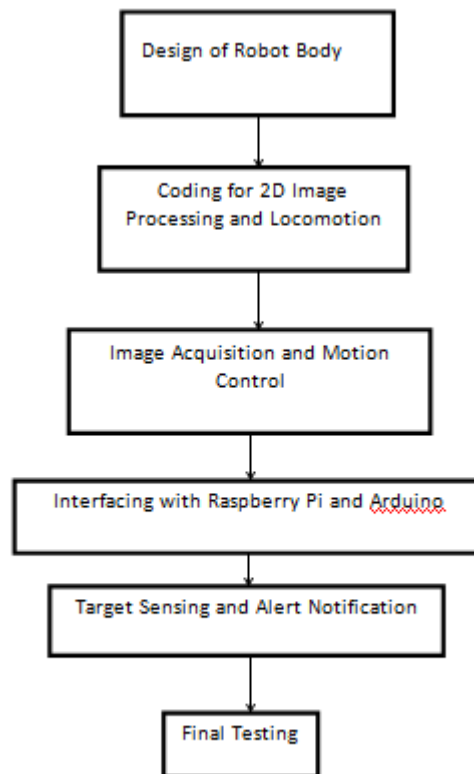
II. BLOCK DIAGRAM

Fig1. Block Diagram of Design

III. HARDWARE AND SOFTWARE

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

The Model B+ replaced the Model B in July 2014 and was superseded by the Raspberry Pi 3 in February 2016. It has 40 GPIO pins, which they support I2C, UART and SPI Interfacing. It's got 4 USB ports, with a better hotplug and overcurrent behaviour. It's got 1GB of in built RAM and a microSD socket supporting upto 128GB for the ROM. It uses switching regulators, reducing the power consumption. The 3.5mm jack provides better output audio helping in communication.
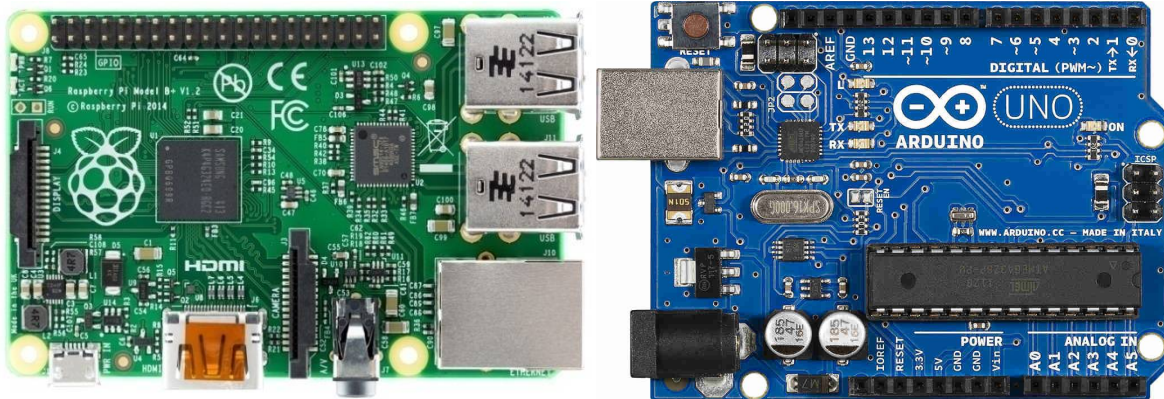
Specifications:

Feature	Raspberry Pi B+	Arduino UNO
Processor Used	ARM	Atmega 328 Microcontroller
Operating Voltage	5v	5v
Digital Pins	17	14
Flash Memory	32k	1GB
Clock Speed	16MHz	900MHz

Power Supply: The power required for both the boards use the USB power supply of a max of 2.1A and 5V.
The different pins on the board are:

- 5V: The regulated 5v ON board supply is used for powering most of the sensors like the laser diode, ultrasonic sensor, proximity sensor, etc.
- 3.3v: All the GPIO pins of the Raspberry give 3.3V output. And so does the 3.3v pin of Arduino
- GND : Ground pins

Microservomotor:

SPECIFICATIONS:
- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kgf·cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~5V)
- Dead band width: 10 μs
- Temperature range: 0 ℃ – 55 ℃

Tiny and lightweight with high output power, this tiny servo is perfect for RC airplane, helicopter, quadcopter or robot. This servo has metal gears for added strength and durability. Servo can rotate approximately 180 degrees(90 in each direction) and works just like the standard kinds but smaller. It comes with 3 horns(arms) and hardware.

Torque Motors:
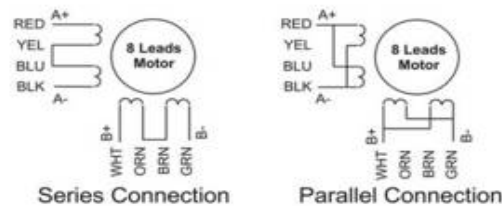
Specifications:
- Weight: 3.8kg
- Holding Torque: 85kgcm
- Motor length: 118mm
- Resistance: 0.87 ohms
- Step angle: 1.8°
- Insulation: Class B [130°C]

A torque motor is a specialized form of electric motor which can operate indefinitely while stalled, that is, with the rotor blocked from turning, without incurring damage. In this mode of operation, the motor will apply a steady torque to the load (hence the name). Torque motors are normally induction motors of toroidal construction. Their main differences from other similar motors are their wide diameters, to allow for high levels of torque, and their thermal performance, to allow their continuous operation while drawing high current in a stalled state.

**Waveshare Raspberry Pi Camera:**

Specifications:
- Night Vision Raspberry Pi camera
- 5 MP 5V5647 Sensor
- Diagonal : 75.7 degrees

- Supports connecting infrared LEDs
- Dimension: 25mm * 24mm

The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the BCM2835 processor. The sensor itself has a native resolution of 5 megapixel, and has a fixed focus lens onboard. The camera is capable of 2592 x 1944 pixel static images, and also supports 1080 p @ 30 fps, 720 p @ 60 fps and 640 x480 p 60/90 video recording. The camera is supported in the latest version of Raspbian, the Raspberry Pi's preferred operating system.

DESIGNING OF ROBOTIC LEGS:
Of the six legs, each legs will contain two servomotors s that are connected by two leg linkages . Each leg section will be machined from 1/4" or 1/2" aluminium plate. The inner and outer leg sections will come in a left and right handed variety while the middle leg section will be the same on both sides. The leg sections will be bolted to the microservomotors using small bolts at the servo mounting flanges and at the servos mounting disk .
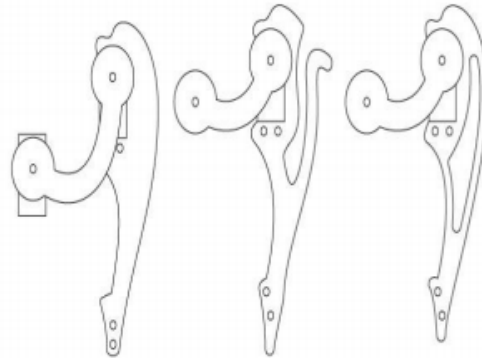
Embedded C:
Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. Embedded C usesmostof the syntax and semantics of standard C, e.g., main() function, variable definition, datatype declaration, conditional statements (if, switch, case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc. The Arduino UNO is programmed using Embedded C.

Python:
Python is a widely used high level programming language. It supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library. The Raspberry Pi B+ is programmed using Python.

SimpleCV:
SimpleCV is an interface for Open Source machine vision libraries in Python. It provides a consise, readable interface for cameras, image manipulation, feature extraction, and format conversion. All the image acquisition techniques, namely, Cameras, video files, images, and video streams are all interoperable. The information for image processing can be easily extracted, operated on and manipulated or stored. Also, the manipulations are quicker.

IV. RESULT AND DISCUSSION

The raspberry Pi cam keeps sensing for motion and once it's detected, it sends you an alert email and a text to your mobile phone.

Motion Detection:
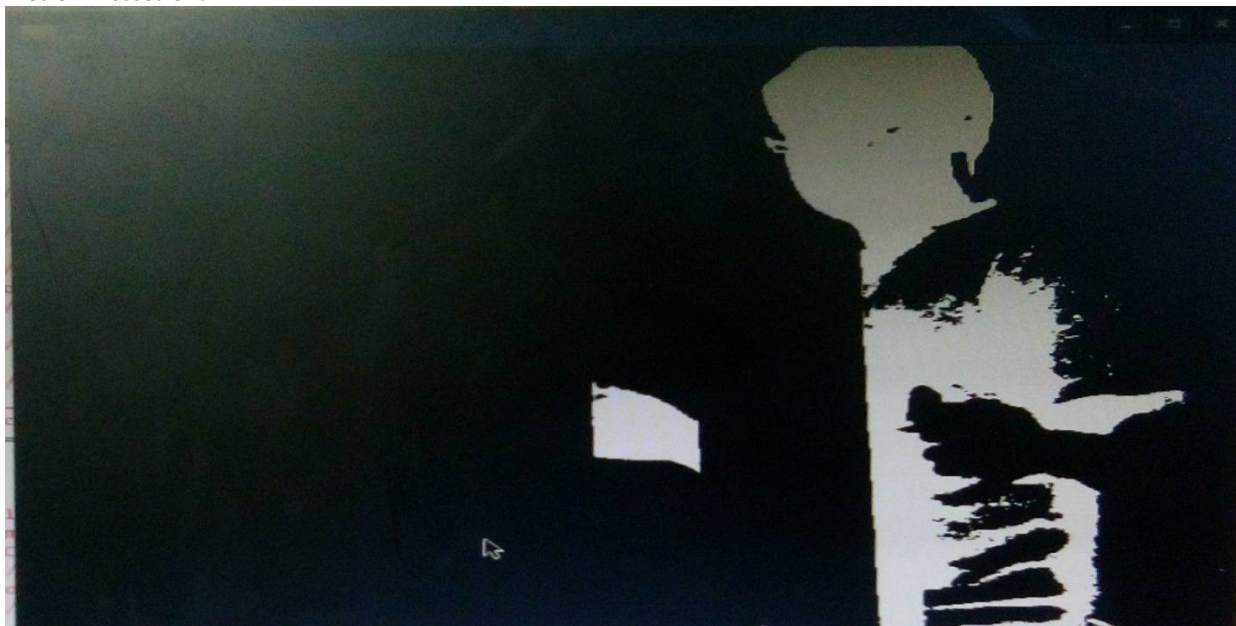
Email Alert:

Muhammad Safwat <safwatchamp@gmail.com>   6:20 PM (6 minutes ago)
to me

There has been trespassing detected at your premises.

Using a DNS [Domain Name server], we can route the domain name to the IP address of the router to which our Raspberry Pi and Arduino are connected, so that we can get live web streaming of the Waveshare Raspberry Pi Camera connected.

And finally, using XRDP library, we can send commands to the Robot from a remote location. XRDP uses the remote desktop protocol to present a GUI to the user, present in a remote location.

Due to remote access, different sensors can be attached to the final robot, based on its application. For the defense intended Hexapod, we can attach a LWIR (Long wave infrared red) sensor which is more accurate as it is a thermal sensing camera. It can be used for precise target location in acute darkness and also for temperature calculation from remote location. Rubber grips attached to its legs can give it wall climbing abilities. The aluminium casing provides it good temperature stability. Ultrasonic sensors can be attached to the Raspberry Pi for more precise distance measurements. A laser diode attached to it can provide the necessary guidance to the soldiers.

Equipped with all these facilities and a few more like enhanced durability, jumping mechanism using springs, waterproof casing and others can be of very good assistance for the soldiers during location of mines, hidden terrorists, remote surveillance of dangerous areas and many more. It can certainly bring down the number of casualties and protect many precious lives of our soldiers.

For the domestic purpose, we can use a TASER gun which is an electroshock weapon that uses electrical current to disrupt voluntary control of muscles. The user can remotely control his device and take the necessary action, if it doesn't violate the Arms Act, 1959.

V. CONCLUSION

The final model will be a Hexapod will multi terrain tranversability. It can determine the location of terrorists and other hazardous weaponry like mines. It can assist the soldiers through dangerous locations safely. The domestic version of the same provides an alert to the user in case of any intrusion. It also provides live streaming and remote access of the robot.

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