Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance

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Abstract:

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand. The Robot can be moved in all the eight directions (open,close,up,down, front, back, left and right) through predefined keys assigned from the android mobile application. The paper aims in designing a moving Robotic arm which is operated using computer wirelessly from a remote location and also which is capable of Picking and Placing of many objects. A video camera is arranged at the robot side for transmitting the audio and video signals.

Keywords: Robotic Arm, Raspberry Pi, Zigbee, Video Surveillance, Camera, Fabrication.

Introduction:

The advent of new high-speed technology and the growing computer Capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices, new drivers and advanced control algorithms. This project describes a new economical solution of robot control systems. The presented robot arm control system can be used for different sophisticated robotic applications.

ZigBee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless M2M networks. The ZigBee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz's. ZigBee devices have the ability to form a mesh network between nodes. Meshing is a type of daisy chaining from one device to another. This technique allows the short range of an individual node to be expanded and multiplied, covering much larger area.

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 for the robotic controlling in the project is Raspberry Pi processor. The data sent from PC over Zigbee transmitter will be received by Zigbee receiver module connected to processor. The Raspberry Pi processor reads the data and decides the direction and operates the DC motors connected to it accordingly.The Raspberry Pi processor is programmed using embedded Linux.

Features:

1. Controlling of robot through PC.
2. Zigbee Wireless communication.
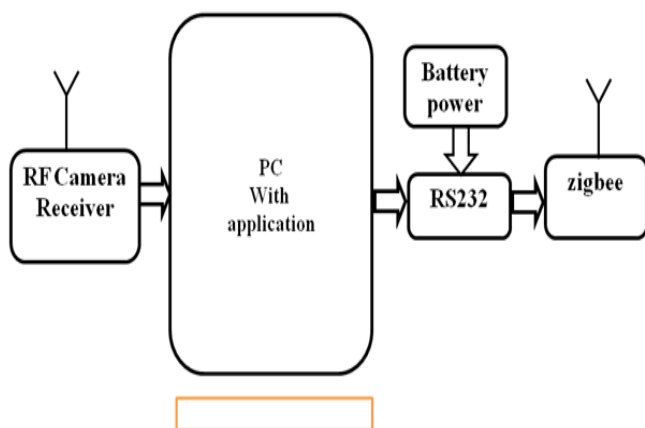3. Pick and Place of objects.
4. Web camera audio & video capturing.

FIG : Block diagram of transmitter section of Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance.
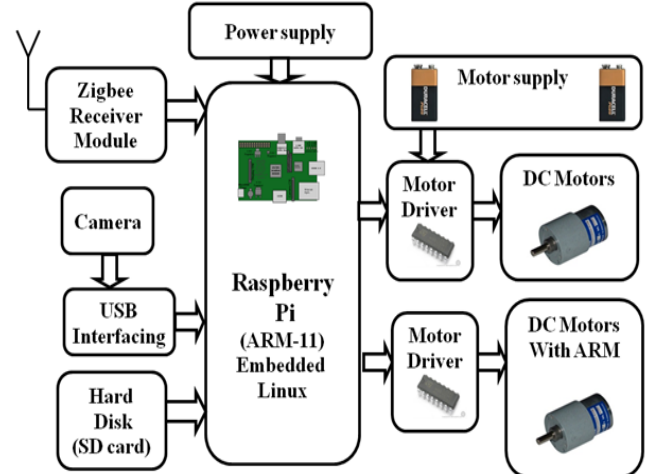

FIG: Block diagram of receiver section of Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance

The main blocks of this project are:

1. Micro processor (ARM-11)

2. Zigbee transceiver modules.

4. DC motor with driver

5. Robotic ARM.

6. RS232 with PC.

7. Wireless Camera.

ARM Processor

Differences between microprocessor and microcontroller:

Microprocessor:

1. The c.p.u, memories, timers, Input/output ports, serial communication, interrupts etc.., all these are located on different chips and are externally connected to the processing unit.
2. Different chips occupy more space; more power consumption is required and more cost.

3. Microprocessors are used in products like general purpose computers.

4. Different kinds of software applications can be loaded and can be used simultaneously.

5. Multitasking can be done using microprocessor.

6. The memory size, number of ports etc.., can be configured according to the requirement in our application.

7. A large instruction set can be used for the applications using microprocessor.

8. The clock rates are faster when compared to micro controller.
   They are in gega hertz for microprocessor.

Microcontroller:

1. The central processing unit, serial communication, timers,

Memories, interrupts, input/output ports etc.., are equipped on the same single chip.

2. It occupies less space, so it consumes less power, and also the cost also very low when compared to microprocessor.

3. Used for products that performs only a specified task.

eg: air conditioner, microwave oven, remote controls etc..,

4. Only a single software application is generally used.

5. Using microcontroller only a specified task can be done basing on specified time periods.

6. The memory size, number of ports etc.., are very limited.

7. A compact instruction or a reduced instruction set is generally used for the applications when we use microcontroller.

8. The clock rates are slower when compared to microprocessor. They are in mega hertz.

D.C. Motor:

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed).

Arm Processor

- ARM Processor was developed at Acorn computer limited of Cambridge, England between 1983 and 1985.
- This was after RISC concept came out at Stanford and Berkeley universities in 1980.
- ARM uses Enhanced RISC Architecture.
- ARM (Acorn RISC machine) limited was found in 1990.
- ARM designed basic core structure and licensed it to many partners who develop and fabricate new Micro Controllers and different chips.
- ARM processor is mainly intended in the development of embedded applications which involve complex computations (High-end applications).

Arm Architecture:

- ARM architecture is based on Enhanced RISC architecture (deviates from classic RISC architecture).
- Embedded applications need to have :
- High code density
- Low power consumption rate
- Small silicon foot print
- A large uniform register file (bank).
- Load-Store architecture, where data processing operations involve only registers but not memory locations.
- Uniform and Fixed length instructions.
- Good speed/power consumption ratio.
- High code density.

Enhancements to Classic RISC architecture:

- Control over ALU and Shifter (Barrel Shifter) which helps maximum usage of hardware on the chip.
- Auto increment and Auto decrement of addressing modes to optimize program loops.
- Load and Store multiple data elements through a single instruction, which increases data throughput.
- A lot of branch instructions which can be used in conjunction with a number of instructions, which maximizes execution throughput.

Raspberry Pi

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 Egoman. All of these companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. 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), VideoCore 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 Foundation's goal was to offer two versions, priced at US$25 and US$35. They started accepting orders for the higher priced model B on 29 February 2012, and the lower cost model A on 4 February 2013.
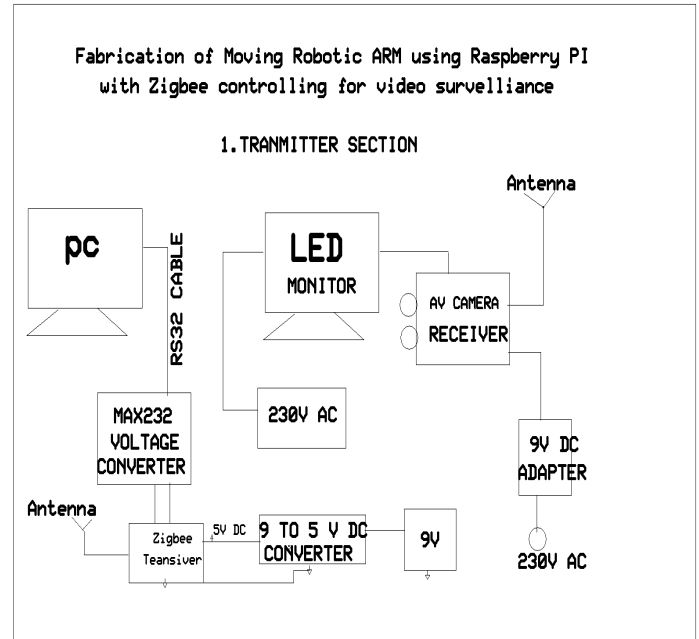
Implementation:

Fig: schematic diagram (Transmitter section) of Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance
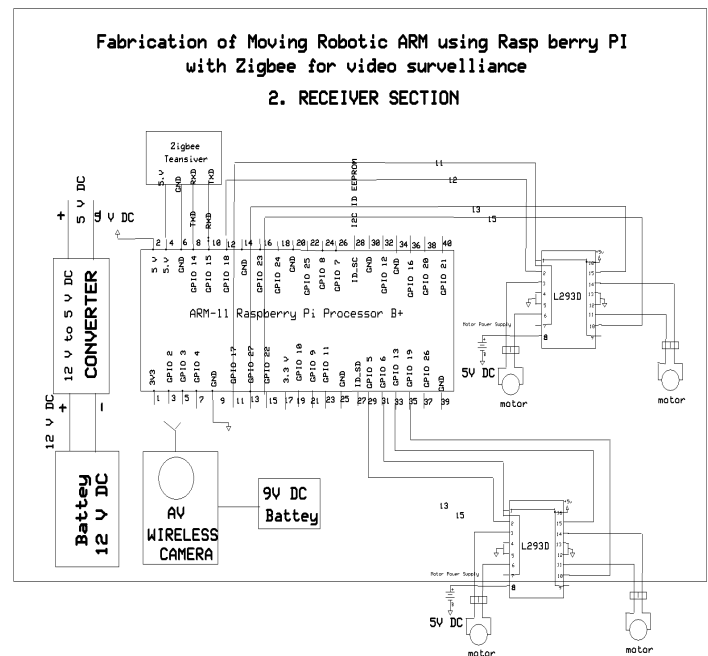

Fig: schematic diagram (Receiver section) of Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance

The above schematic diagram of **Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance** explains the interfacing section of each component with micro processor and input output modules.

Advantages:

1. Moving Robotic Design using ARM-11 processor
2. Fast response and very user friendly.
3. Zigbee based reliable communication.
4. Usage of camera with processor
5. Robot controlling using DC motor
6. Wireless PC security based robotic ARM control.
7. Low power consumption
8. Live video streaming monitoring.
9. Efficient design.
10. Easy to operate.

Disadvantages:

• If the camera fails to operate the user cannot capture video.

• While robotic arm moving fast camera will not operate perfectly.

• Robot controlling is to be monitored continuously for battery discharge.

• Wireless camera distance is limited.

Applications:

1. It can be used in Production industry, In mass production and Automobile Industry.

2. Used at industries, factories and houses where pick and place objects/things needed.

3. Security applications like disposal of landmines/bombs and Battrlefiels,etc.

Result:

The project "**Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance**" was designed such that a moving Robotic ARM which was controlled through PC over wireless Zigbee technology. The Robot was also transmit the live video and audio streaming to transmitter section using Wireless camera for observe and easy handle the objects in front of the robot.

Conclusion:

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

Future Scope:

Our project "**Fabrication of Moving Robotic ARM using Raspberry Pi with zigbee controlled for Video surveillance**" is mainly intended to designMMoving Robot ARm which was controlled through PC over Zigbee technology with ARM11 processor. The Robot can be moved in all the eight directions (open, close, up, down, front, back, left and right) through predefined keys assigned from the PC with application. This robot ARM system facilitates to observe the live video and audio streaming for easy to identify and handle the objects. The controlling device for the robotic controlling in the project is Raspberry Pi processor. The data sent from PC over Zigbee transmitter will be received by Zigbee receiver module connected to processor. The Raspberry Pi processor reads the data and decides the direction and operates the DC motors connected to it accordingly. The Raspberry Pi processor is programmed using embedded Linux.

This project can be extended using high efficiency GSM and GPS modules, we can find the location of the particular objects through SMS,So that sometimes

we can easily identify the object time and place easily. And also by adding multiple sensors (like metal and obstacle sensors)to the system, we can use this moving robotic arm into multi used for finding the metal objects or bombs and also we can auto control of robotic arm using obstacle sensor. By adding these features to robotic arm, this can be used to all areas like industries,homes,army and many more places.

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