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Pi-Robot implementation using Raspberry Pi controlling through MATLAB

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ABSTRACT:

The project aims in designing a Robot which is operated using computer wirelessly from a remote location using zigbee. The Robot controlling is done through PC using MATLAB software. The Robot section is designed using advanced computer Raspberry Pi.

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 control system can be used for different sophisticated robotic applications.

1.INTRODUCTION:

The project aims at designing a Robot which is controlled through Android phone over Wi-Fi technology. The Robot can be moved in all the four directions (front, back, left and right) through predefined keys assigned in the android application. This robot system facilitates the owners to monitor their surroundings remotely from anywhere in the world through a single electronic eye. This system comprises of a Microcontroller based electronic eye monitoring system, which is a PIR sensor (Passive Infrared) that is used to

detect the presence of human beings (thieves). The robot also alerts the user when any fire was detected using fire sensor.

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.

Wi-Fi (Short for **Wi**reless **Fi**delity) is a wireless technology that uses radio frequency to transmit data through the air. Wi-Fi has initial speeds of 1mbps to 2mbps. Wi-Fi transmits data in the frequency band of 2.4 GHz. It implements the concept of frequency division multiplexing technology. Range of Wi-Fi technology is 40-300 feet.

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 Android mobile phone over Wi-Fi will be received by Wi-Fi 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 robot also comprises of sensors like fire and PIR sensor which alerts the user when fire was detected or any humans were detected. The Raspberry Pi processor is programmed using embedded Linux.

Features:

1. Wi-Fi based user-friendly interfacing.
2. Usage of Android phone's Wi-Fi
3. Low power consumption

2.OVERVIEW:

MATLAB (**mat**rix **lab**oratory) is a computing numerical environment and fourth generation programming language. Developed by Math works, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and FORTRAN

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.

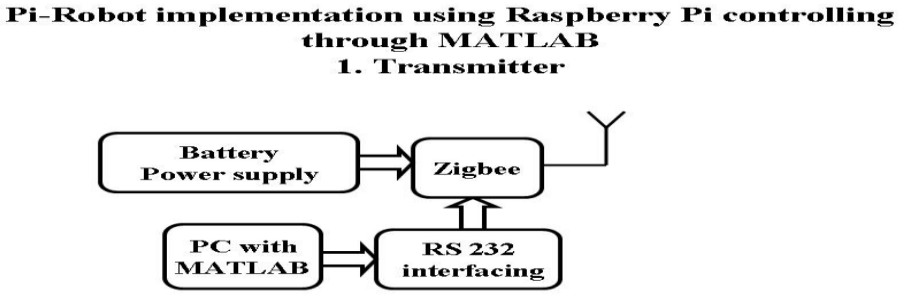
The modules in the project are: Zigbee modules for establishing wireless communication through MATLAB, Robot, DC motors is attached to the robot arm for the movement of the robot and Microcontroller which performs the controlling operations of Robot.

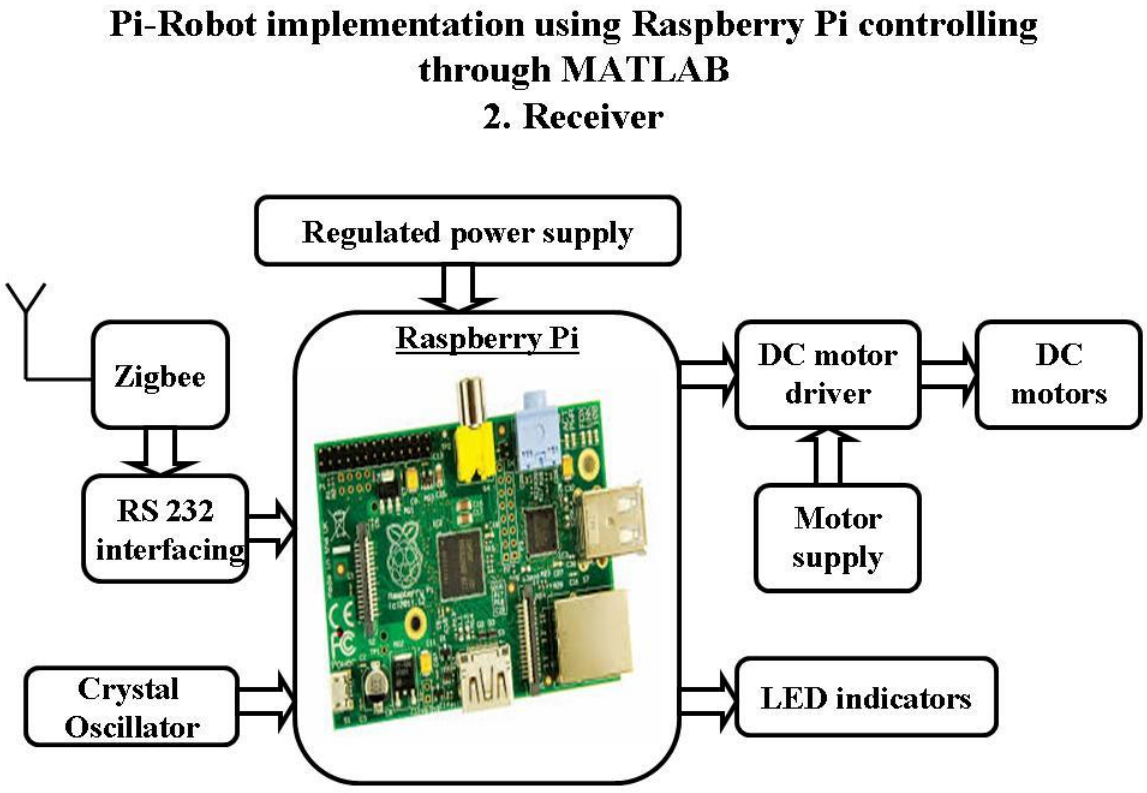
The Raspberry Pi is a low cost, **credit-card sized computer** that can be used in electronics projects. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

The controlling device of the whole system is a Raspberry to which Zigbee module; DC motors of robot are interfaced through a motor driver. Whenever the appropriate keys are pressed in the keyboard of computer, the data related to those keys will be transmitted over Zigbee module through MATLAB. This data will be received by

Zigbee module at robot and this data is fed as input to the Raspberry Pi. The Raspberry Pi checks the data with the program embedded in it and performs appropriate actions on the robot.

BLOCK DIAGRAM:





ARM11: The ARM11 micro architecture (announced 29 April 2002) introduced the ARMv6 architectural additions which had been announced in October 2001. These include SIMD media instructions, multiprocessor support and a new cache architecture. The implementation included a significantly improved instruction processing pipeline, compared to previous ARM9 or ARM10 families, and is used in smart phones from Apple, Nokia, and others. The initial ARM11 core (ARM1136) was released to licensees in October 2002.

The ARM11 family is currently the only ARMv6-architecture cores. There are however ARMv6-M cores (Cortex-M0 and Cortex-M1), addressing microcontroller applications;[1] ARM11 cores target more demanding applications.

Differences from ARM9

In terms of instruction set, the ARM11 builds on the preceding ARM9 generation. It incorporates all ARM926EJ-S features and adds the ARMv6 instructions for media support (SIMD) and accelerating IRQ response.

Micro architecture improvements in ARM11 cores[2] include:

- SIMD instructions which can double MPEG-4 and audio digital signal processing algorithm speed
- Cache is physically addressed, solving many cache aliasing problems and reducing context switch overhead.
- Unaligned and mixed-endian data access is supported.
- Reduced heat production and lower overheating risk
- Redesigned pipeline, supporting faster clock speeds (target up to 1 GHz)
  - Longer: 8 (vs 5) stages
  - Out-of-order completion for some operations (e.g. stores)
  - Dynamic branch prediction/folding (like XScale)
  - Cache misses don't block execution of non-dependent instructions.
  - Load/store parallelism
  - ALU parallelism
- 64-bit data paths

JTAG debug support (for halting, stepping, breakpoints, and watch points)

was simplified. The Embedded ICE module was replaced with an interface which became part of the ARMv7 architecture. The hardware tracing modules (ETM and ETB) are compatible, but updated, versions of those used in the ARM9. In particular, trace semantics were updated to address parallel instruction execution and data transfers.

ARM makes an effort to promote good Verilog coding styles and techniques. This ensures semantically rigorous designs, preserving identical semantics throughout the chip design flow, which included extensive use of formal verification techniques. Without such attention, integrating an ARM11 with third party designs could risk exposing hard-to-find latent bugs. Due to ARM cores being integrated into many different designs, using a variety of logic synthesis tools and chip manufacturing processes, the impact of its register-transfer level (RTL) quality is magnified many times.[3] The ARM11 generation focused more on synthesis than previous generations, making such concerns be more of an issue.

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).

Fig 3.19: DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator. Figure shows a picture of a typical DC motor, Figure shows a picture of a DC armature, and Fig shows a picture of a typical stator. From the picture you can see the armature is made of coils of wire wrapped around the core,

and the core has an extended shaft that rotates on bearings. You should also notice that the ends of each coil of wire on the armature are terminated at one end of the armature. The termination points are called the commutator, and this is where the brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine

WI-FI:

WiFi or WLAN as it is commonly known is fast becoming the preferred mode of connecting to the internet. Many people are not aware of the **descriptions and explanations** related to it. **WiFi** gets its name from a certification called **Wireless Fidelity** given to **networks** operating under 802.11 standards. **WiFi** allows computers, PDAs and other devices to connect to a broadband connection in a **wireless mode**. The 802.11 standard defines the **wireless communication** operating via electromagnetic waves. While reading the **descriptions and explanations** related to WiFi, one should remember there are different **modes for wireless networks** like Infrastructure mode and Ad-Hoc mode that can be used for different criteria.

WiFi allows us to create wireless local area networks at high speed. In practice, the WiFi can connect laptops, desktops, PDAs or other devices (printers, game consoles) to a broadband connection (300 Mbps) over a radius of several meters indoors (usually between 20 and 50 meters). In an open environment, the range can reach over several hundred of meters in optimal conditions.

ISPs are starting to equip areas with high concentrations of internet users (stations, airports, hotels, trains, etc.) with wireless internet access. These access areas are called "hot spots".

Wifi is a mechanism for wirelessly connecting electronic devices. A device enabled with Wi-Fi, such as a personal computer, video game console, smart phone, or digital audio player, can connect to the Internet via a wireless network access point. An access point (or hotspot) has a range of about 20 meters (65 ft) indoors and a greater range outdoors. Multiple overlapping access points can cover large areas.

A Wi-Fi enabled device such as a PC, video game console, mobile phone,

MP3 player or PDA can connect to the Internet when within range of a wireless network connected to the Internet. The coverage of one or more interconnected access points — called a hotspot — can comprise an area as small as a single room with wireless-opaque walls or as large as many square miles covered by overlapping access points. "Wi-Fi" is a trademark of the Wi-Fi Alliance and the brand name for products using the IEEE 802.11 family of standards. Wi-Fi is used by over 700 million people. There are over four million hotspots (places with Wi-Fi Internet connectivity) around the world, and about 800 million new Wi-Fi devices are sold every year. Wi-Fi products that complete Wi-Fi Alliance interoperability certification testing successfully may use the "Wi-Fi CERTIFIED" designation and trademark.

Advantages:

1. Highly efficient and user friendly design.
2. Easy to operate.
3. Low power consumption.
4. Wifi based user-friendly interfacing.
5. Usage of Android mobile over WiFi wireless communication
6. Fire detection and alarm alerts
7. Human presence detection and also alerting through alarm
8. Efficient design.

Disadvantages:

1. Interfacing WiFi to ARM-11 processor is highly sensitive
2. Wi-Fi wireless communication supports only for limited distance
3. Sensors based alerting only is present but not controlling.

Applications:

1. Emergency communication based controlling of robot
2. Used at industries, factories where accidents occurs frequently
3. Industrial Security Applications

Result:

The project "**Fabrication of Robot using Raspberry Pi with Android Wifi controlled for human and fire detection alerts**" was designed such that a Robot which was controlled through Android phone over Wi-Fi technology. The Robot was also used to alert through buzzer alarm if it detects and human presence and also fire alerts using PIR and Fire sensors.

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 Robot using Raspberry Pi with Android Wifi controlled for human and fire detection alerts**" is mainly intended to design Robot which was controlled through Android phone over Wi-Fi technology.

The Robot can be moved in all the four directions (front, back, left and right) through predefined keys assigned from the mobile application. This robot vehicular system facilitates the owners to monitor their surroundings using fire and human presence detection using PIR sensor at remotely.

The controlling device for the robotic controlling in the project is Raspberry Pi processor. The data sent from Android mobile phone over Wi-Fi will be received by Wi-Fi 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 robot also comprises of sensors like fire and PIR sensor which alerts the user when fire was detected or any humans were detected. The Raspberry Pi processor is programmed using embedded Linux.

This project can be extended using high efficiency GSM module using which the robot can be controlled from unlimited distance. The GSM module gives the intimation of the name plate details to the predefined number through SMS. The GPS module can also give the location of the fire or as leakages were detected in case of emergencies.

The vehicle location and also tracking can be done using this project idea.

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