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Hardware design of a Motion Enable Robotic ArmControlled through a Smart Phone

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ABSTRACT: This project is a method for controlling a Robotic arm using an application build in the android platform. The android phone and raspberry pi board is connected through Wi-Fi. As the name suggests the robotic arm is designed as it performs the same activity as a human handworks. A signal is generated from the android app which will be received by the raspberry pi board and the robotic arm works according to the predefined program. The android application is the command centre of the robotic arm. The different data will control the arm rotation.

Keywords:Wi-Fi, android,raspberry pi,android phone

(I) INTRODUCTION

The advent of new high-speed technology and the growingcomputer Capacity provided realistic opportunity for newrobot controls and realization of new methods of controltheory. This technical improvement together with the need forhigh performance robots created faster, more accurate andmore intelligent robots using new robots control devices, newdrivers and advanced control algorithms. This projectdescribes a new economical solution of robot control systems.In general; the robots are controlled through wired network.The programming of the robot takes time if there is anychange in the project the reprogramming has to be done. Thusthey are not user friendly and worked along with the userpreferences. To make a robot user-friendly and to get themultimedia tone in the control of the robot, they are designedto make user commanded work. The modern technology hasto be implemented to do this. For implementing the moderntechnology it should be known by all the users to make use ofit. To reach and to full-fill all these needs we are using androidmobile as a multimedia, user friendly device to control therobot. This idea is the motivation for this project and the maintheme of the project.In this modern environment everybody uses smart phoneswhich are a part of their day-to-day life. They use all theirdaily uses like newspaper reading, daily updates, socialnetworking, and all the apps like home automation control,vehicle security, human body anatomy, health maintenance,etc has been designed in the form of applications which can beeasily installed in their hand held smart phones. This projectapproached a robotic movement control trough the smartphones.

Hence a dedicated application is created to control anembedded robotic hardware. The application controls themovement of the robot. The embedded hardware is developedon 8051 microcontroller and to be controlled by a Smartphoneon the basis of Android platform. 8051 controller is to receivethe AT commands from the Smartphone and takes the dataand controls the motors of the robot by the motor driverL293D. The robot can able to move forward, reverse, left andright movements. The Smartphone is been interfaced to thedevice by using Bluetooth. A Bluetooth device HC-05 moduleis going to be added to 8051 microcontroller to receivecommands from smart phone. A wireless camera is mountedon the robot body for spying purpose even in completedarkness by using infrared lighting.

(II) RELATED WORK

(A) A Bluetooth-based Architecture for Android Communication with an Articulated Robot

An Articulated Robotic Arm which is used in Industry wasproposed by Sebastian van Delden and Andrew Whigham. Itcan be controlled by an android device in an industrial fixedsetup. It can pick and place, and do some wielding workswhich human can"t do. By using the device control we noneed to reprogram for every time we use the robot for differentworks. It can connect various types of other robot too forcontrolling them.In industrial robotic environments there are many differentrobots performing a variety of tasks. Each robot is controlledby its own teach pendant or via a networked socketapplication. However, to monitor the status or make minorchanges to the programming of the robot, the user must obtainaccess to the pendant or terminal. In an effort to eliminate thisneed, this paper introduces an

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android platform thatcommunicates with robots over a Bluetooth connection.Practical applications: To demonstrate one of the practicaluses of this application, a typical manufacturing floorenvironment was simulated. Two Robotic systems were set upwith looping programs. The first simulated a spot welding lineby visiting a starting point just above an apparatus containinga model vehicle and then quickly visiting six points around themodel. The second simulated a palletizing line where the robotwas programmed to pick and place a cylinder up from a palletand place it into another pallet and vice versa. Each systemwas equipped with the typical "stop emergency" and "stopnormal" commands that are commonplace in factories.The stop emergency command breaks the robot immediatelywhile the stop normal command allowed the robot to finish itscurrent cycle in the program.The robots were then connected to the Bluetooth serverapplication and the Android application was started. Thisdemonstration showed the case in which a user could switchbetween robots running different programs quickly and sendthose robot commands. Both commands executed very well on both simulations.

(B) Development of A Wireless Device Control Based Mobile Robot Navigation System.

The system is proposed by PheySiaKwek,Zhan Wei Siew,Chen How Wong,, BihLiiChua, Kenneth Tze Kin Teo. Thegeneral computer with well-designed software Centralizedsoftware can control the moveable mobile robot. Thecommands send trough the mobile device they used Wi-Fi as atransmission protocol. The robot is set on a moveable platformand can is assisted with an IR reflective terminal to avoidcollision of the robot. The IR signals help the robot to find thecorrect path with no obstacles. The mobile controller is aTablet.

Tablets are highly functional and flexible platform to pair withrobotic autonomy and navigation control. The advantage ofremotely controlling robots using mobile devices is locationindependence. New research is merging towards moreapplications for mobile devices with robots. In this paper, thedesign and development of a mobile robot system with tabletis presented in detail. The wireless communication interfacedbetween the microcontroller and tablet is described.

(C) Range based Navigation System for a MobileRobot.

Range detector navigation system is proposed by NeilMacMillan, River Allen, DimitriMarinakis, and SueWhitesides.They have designed the system to detect an obstacle free pathby using the mobile robot. The robot senses the obstacle byusing ultrasonic sensor. The path obstacles are found by thesensor and are transmitted to the controlling device. It usesgeneral RF communication. The range of the device is higherthan the other projects but it is old type of communicationtechnique. The range of the path is identified and are easily selected the good path.

(D) Mobile Robot Temperature Monitoring SystemControlled by Android Application via Bluetooth

T. Maria Jenifer, T. S. VasumathiPriyadharshini, RajaLavanya& S. Raj Pandian were proposed a autonomous robotsystem which can sense the environment temperature andtransfer the value to a php server via Bluetooth android application.

(III) EXISTING METHOD

In the existing system the Robotic arm presented do not have ability to move forward or backward. They are bit difficult to carry as they can't move from one place to another by their own.

(IV) PROPOSED METHOD

The proposed method is used to overcome the drawback of the existing method. Without the capability of moving, an arm will be of limited use. Hence our work targets to equipped the robotic arm with motion. The project will target to develop a robotic arm which will not only have features which are demonstrated in base paper but will also have the capability of moving.

(V) HARDWARE DESIGN

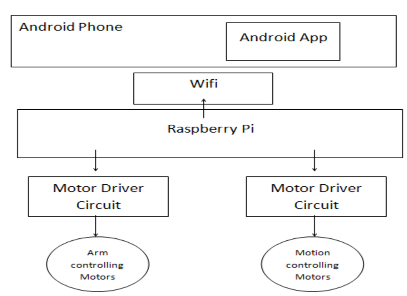
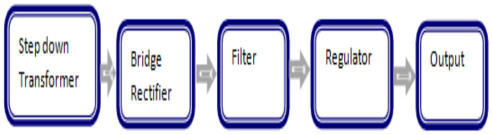


FIG 1 BLOCK DIAGRAM

POWER SUPPLY BLOCK DIAGRAM:



(A)ARM 11: ARM is a 32-bit RISC processor architecture developed by the ARM corporation. ARM processors possess a unique combination of features that makes ARM the most popular embedded architecture today. First, ARM cores are very simple compared to most other general-purpose processors, which means that they can be manufactured using a comparatively small number of transistors, leaving plenty of space on the chip for application specific macro cells. A typical ARM chip can contain several peripheral controllers, a digital signal processor, and some amount of on-chip memory, along with an ARM core. Second, both ARM ISA and pipeline design are aimed at minimizing energy consumption a critical requirement in mobile embedded systems. Third, the ARM architecture is highly modular: the only mandatory component of an ARM processor is the integer pipeline; all other components, including caches, MMU, floating point and other co-processors are optional, which gives a lot of flexibility in building application-specific ARM-based processors. Finally, while being small and low-power, ARM processors provide high performance for embedded applications. For example, the PXA255 XScale processor running at 400MHz provides performance comparable to Pentium 2 at 300MHz, while using fifty times less energy.

(B) 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 in two board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. 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, 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 persistent storage.The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C, Java and Perl.

FIG 2 Raspberry Pi

(C)Ethernet: Ethernet is a family of computer networking technologies for local area networks (LANs) commercially introduced in 1980. Standardized in IEEE 802.3, Ethernet has largely replaced competing wired LAN technologies. Systems communicating over Ethernet divide a stream of data into individual packets called frames. Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted. The standards define several wiring and signalling variants. The original 10BASE5 Ethernet used coaxial cable as a shared medium. Later the coaxial cables were replaced by twisted pair and fiber optic links in conjunction with hubs or switches. Data rates were periodically increased from the original 10 megabits per second, to 100 gigabits per second.

FIG 3 Ethernet

(E)RS-232 Interfaces: The RS-232 interface is the Electronic Industries Association (EIA) standard for the interchange of serial binary data between two devices. It was initially developed by the EIA to standardize the connection of computers with telephone line modems. The standard allows as many as 20 signals to be defined, but gives complete freedom to the user. Three wires are sufficient: send data, receive data, and signal ground. The remaining lines can be hardwired on or off permanently. The signal transmission is bipolar, requiring two voltages, from 5 to 25 volts, of opposite polarity.

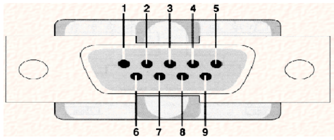


FIG 3 DB9 CONNECTOR

(F)MAX-232: The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels.

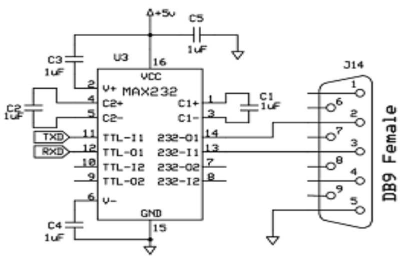


FIG 4 Schematic diagram of MAX-232

(G) WiFi: Wi-Fi or WiFi is a technology that allows electronic devices to connect to a wireless LAN (WLAN) network, mainly using the 2.4 gigahertz (12 cm) UHF and 5 gigahertz (6 cm) SHF ISM radio bands. A WLAN is usually password protected, but may be open, which allows any device within its range to access the resources of the WLAN network.The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network" (WLAN) product based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards.[2] However, the term "Wi-Fi" is used in general English as a synonym for "WLAN" since most modern WLANs are based on these standards. "Wi-Fi" is a trademark of the Wi-Fi Alliance. The "Wi-Fi Certified" trademark can only be used by Wi-Fi products that successfully complete Wi-Fi Alliance interoperability certification testing.Devices which can use Wi-Fi technology include personal computers, video-game consoles, smartphones, digital cameras, tablet computers, digital audio players and modern printers. Wi-Fi compatible devices can connect to the Internet via a WLAN network and a wireless access point. Such an access point (or hotspot) has a range of about 20 meters (66 feet) indoors and a greater range outdoors. Hotspot coverage can be as small as a single room with walls that block radio waves, or as large as many square kilometres achieved by using multiple overlapping access points.Wi-Fi is less secure than wired connections, such as Ethernet, precisely because an intruder does not need a physical connection. Web pages that use TLS are secure, but unencrypted Internet access can easily be detected by intruders. Because of this, Wi-Fi has adopted various encryption technologies. The early encryption WEP proved easy to break. Higher quality protocols (WPA, WPA2) were added later. An optional feature added in 2007, called Wi-Fi Protected Setup (WPS), had a serious flaw that allowed an attacker to recover the router's password.[3] The Wi-Fi Alliance has since updated its test plan and certification program to ensure all newly certified devices resist attacks.

(H) DC MOTOR A DC motor is an electric motor that runs on DC electricity. It works on the principle of electromagnetism. A current carrying conductor when placed in an external magnetic field will experience a force proportional to the current in the conductor.

OPERATION OF A DC MOTOR: There are two magnetic fields produced in the motor. One magnetic field is produced by the permanent magnets and the other magnetic field is produced by the electrical current flowing in the motor windings. These two fields result in a torque which tends to rotate the rotor. As the rotor turns, the current in the windings is commutated to produce a continuous.

FIG 5 HARDWARE OF THE PROJECT

WORKING PRINCIPLE

In this project, we are giving the complete description on the proposed system architecture. Here we are using Raspberry Pi board as our platform. It has an ARM-11 SOC with integrated peripherals like USB, Ethernet and serial etc. On this board we are installing Linux operating system with necessary drivers for all peripheral devices and user level software stack which includes a light weight GUI based on XServer, V4L2 API for interacting with video devices like cameras, TCP/IP stack to communicate with network devices and some standard system libraries for system level general IO operations. The Raspberry Pi board equipped with the above software stack is connected to the outside network and a camera is connected to the Raspberry Pi through USB bus.The architecture of the web server has the following layers.

- In the lower level the web server has the physical hosting interfaces used for storing and maintaining the data related to the server.
- Above the Physical hosting interface the server has HTTP server software and other web server components for bypass the direct interaction with the physical interaction with the lower levels.
- The final layer has the tools and services for interacting with the video streams which includes the Image codec and storing interfaces, connection managers and session control interfaces etc.

After connecting all the devices power up the device. When the device starts booting from flash, it first loads the Linux to the device and initialize all the drivers and the core kernel. After initialization of the kernel it first check weather all the devices are working properly or not. After that it loads the file system and starts the start-up scripts for running necessary processes and daemons. Finally it starts the main application.When our application starts running it first check all the devices and resources which it needs are available or not. After that it checks the connection with the devices and gives control to the user.

ADVANTAGES:

- Low support cost, easy to implement and low power consumption and controlling is done by using web technology.
- Avoid unplanned lab operation interruptions.
- Increase laboratory efficiency.
- Remotely track critical system parameters.

APLLICATIONS:

- Used to navigate the robot by the movement of the fingers.

FUTURE SCOPE

- The cost of ARM11 is more that's why in future we can implement this system using ARM CORTEX A8, Beagle bone etc as well as updated processors with high frequencies will work fine.
- As the storage space is also less in future we can also record these live streaming data by connecting external memory storage.
- We can complete our project using wireless technology.
- In future we can provide more security to data by using encryption, decryption techniques.

(VI) CONLUSION

The project "A MOTION ENABLE ROBOTIC ARM CONTROLLED THROUGH A SMART PHONE" has been successfully designed and tested. It has been developed by integrating features of all the hardware components and software used and tested.Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.Secondly, using highly advanced ARM Cortex A8 Processor board and with the help of growing technology the project has been successfully implemented.

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