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Medical Assistant Robot

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***Abstract*: In today's world there is an increasing need to create artificial arms for different inhuman situations where human interaction is difficult or impossible. They may involve taking readings from an active volcano to diffusing a bomb. Here we propose to build a robotic arm controlled by natural human arm movements whose data is acquired through the use of accelerometers. For proper control mechanism and to reduce the amount of noise coming in from the sensors, proper averaging algorithm is used for smoothening the output of the accelerometer. The development of this arm is based on ATmega328 platform along with a personal computer for signal processing, which will all be interfaced with each other using serial communication. Finally, this prototype of the arm may be expected to overcome the problem such as placing or picking hazardous objects or non-hazardous objects that are far away from the user.**

***Keywords*: Arduino UNO, Transmitter, Receiver, LCD Screen, IR Sensors, Bread Board, 12v battery, controlling system**

1. Introduction

Nowadays, robots are increasingly being integrated into working tasks to replace humans especially to perform the repetitive task. In general, robotics can be divided into two areas, industrial and service robotics. International Federation of Robotics (IFR) defines a service robot as a robot which operates semi- or fully autonomously to perform services useful to the well- being of humans and equipment, excluding manufacturing operations. These robots are currently used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture. Besides, it might be difficult or dangerous for humans to do some specific tasks like picking up explosive chemicals, defusing bombs or in worst case scenario to pick and place the bomb somewhere for containment and for repeated pick and place action in industries. Therefore, a robot can be replaced human to do work.

2. Literature survey

A. Head Design and the mechanism of controlling a robotic arm

A Robot is a virtually intelligent agent capable of carrying out tasks robotically with the help of some supervision. Practically, a robot is basically an electro-mechanical machine that is guided by means of computer and electronic programming. Robots can be classified as autonomous, semiautonomous and remotely controlled. Robots are widely used for variety of tasks such as service stations, cleaning drains, and in tasks that are considered too dangerous to be performed by humans. A robotic arm is a robotic manipulator, usually programmable, with similar functions to a human arm. This Robotic arm is programmable in nature and it can be manipulated. The robotic arm is also sometimes referred to as anthropomorphic as it is very similar to that of a human hand. Humans today do all the tasks involved in the manufacturing industry by themselves. However, a Robotic arm can be used for various tasks such as welding, drilling, spraying and many more. A self-sufficient robotic arm is fabricated by using components like micro-controllers and motors. This increases their speed of operation and reduces the complexity. It also brings about an increase in productivity which makes it easy to shift to hazardous materials. The main part of the design is ATMEGA-328p micro-controller which coordinates and controls the product's action. This specific micro controller is used in various types of embedded applications. Robotics involves elements of mechanical and electrical engineering, as well as control theory, computing and now artificial intelligence. According to the Robot Institute of America, A robot is a reprogrammable, multifunctional manipulator designed to move materials, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks.

The robots interact with their environment, which is an important objective in the development of robots. This interaction is commonly established by means of some sort of arm and gripping device or end effectors. In the robotic arm, the arm has a few joints, similar to a human arm, in addition to shoulder, elbow, and wrist, coupled with the finger joints; there are many joints. The design process is clearly explained in the next section with detailed information regarding the components which are used.

B. Head Design, Analysis and Implementation of a Robotic Arm- The Animator

A humanoid robotics is a new challenging field. To co-operate with human beings, humanoid robots not only have to feature human like form and structure, but more importantly, they must have prepared human like behavior regarding the motion, communication and intelligence. The model number of this beginner is ASR K-250. This paper we consider the mechanism and mechanical structure of ASR K-250 (Beginner) and its implementation.

The application of robotics field is broadly used in the field of research, laboratory based work, industrial work to automate process and reduce the human errors. This paper is describing the design of mechanical structure of a robotic arm. This robotic arm is often indicated to move an object from one place to another place. One kind of example of this application is in an industrial area where need to move a weighable object like tank or container or other object. The advantage of automated process results is faster completion time with lowest errors. This paper also describes the implementation of a robotic arm with switching controlled. The application of the force controlled function can be seen in the industrial/manufacturing environments.

C. A Geometric Approach for Robotic Arm Kinematics with Hardware Design, Electrical Design, and Implementation

As technology increases, robots not only become self sufficient through autonomous behavior but actually manipulate the world around them. Robots are capable of amazing feats of strength, speed, and seemingly intelligent decisions; however, this last ability is entirely dependent upon the continuing development of machine intelligence and logical routines [1]. A crucial part in any robotic systems is the modelling and analysis of the robot kinematics. This paper aims to create a straightforward and repeatable process to solve the problem of robotic arm positioning for local autonomy. There have been many methods presented to allow this functionality ([2–4]). However, the majority of these methods use incredibly complex mathematical procedures to achieve the goals. Using a few basic assumptions regarding the working environment of the robot and the type of manipulation to take place, this paper proposes an easier solution which relies solely on the designation of a point in the three-dimensional space within the physical reach of the robotic arm. This solution has been achieved using a strictly trigonometric analysis in relation to a geometric representation of an arm mounted to a mobile robot platform.

In addition to the ability of robustly reaching for an object in space, it is also vital that the robot has some way of autonomously discovering such objects, determining whether they are capable of manipulation, and relaying the coordinates to the arm for positioning. There has been work done in the area of manipulating objects without the ability of autonomously determining their position [5], [6]. The approach in this paper is similar to that used by Xu et al. [6], in which an end effector is capable of retrieving various objects from the floor. The robot is assumed to have already located an object through various means and positioned itself in the correct orientation in front of the object. This robust grasping algorithm can then be combined with other work involving path planning, obstacle avoidance, and object tracking in order to produce a more capable robot. The paper is organized as follows. Section 2 introduces the hardware components needed in this project. Section 3 describes the geometric approach in the modelling and analysis of the robot arm kinematics. Section 4 presents the object detection strategies for a moving robot. Sections 5 and 6 are the mechanical design and the electrical design of the robot arm, respectively.

3. Block diagram

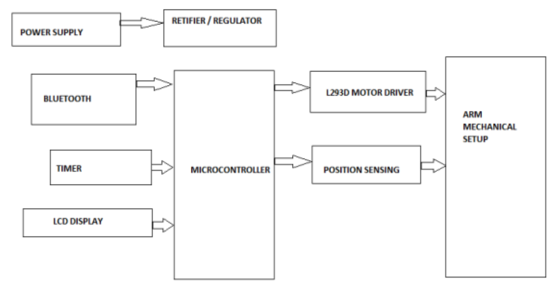

Fig. 1. Block diagram

A. Microcontroller Simulation

The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design. It also finds use in the general hobbyist community and, since no hardware is required, is convenient to use as a training or teaching tool. Support is available for co-simulation of:

- Microchip Technologies PIC10, PIC12, PIC16, PIC18, PIC24, dsPIC33 Microcontrollers.
- Atmel AVR (and Arduino), 8051 and ARM Cortex-M3 Microcontrollers.
- NXP 8051, ARM7, ARM Cortex-M0 and ARM Cortex-M3 Microcontrollers.
- Texas Instruments MSP430, PICCOLO DSP and ARM Cortex-M3 Microcontrollers.
- Parallax Basic Stamp, Freescale HC11, 8086 Microcontrollers.

B. PCB Design

The PCB Layout module is automatically given connectivity information in the form of a netlist from the schematic capture module. It applies this information, together with the user specified design rules and various design automation tools, to assist with error free board design. PCB's of up to 16 copper layers can be produced with design size limited by product configuration.

The programs of the microcontroller have been written in Embedded C language and were compiled using CODE VISION AVR, a compiler used for microcontroller programming. The communication between PC and the microcontroller was established MAX 232 standard and those programs were also done in C language. The following programs are used at various stages for the mentioned

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functions. Serial communication in this program, the various special function registers of the microcontroller are set such that they can send and receive data from the PC. This program uses the serial library to communicate with the ports.

C. AVR compiler

The C programming language is a general-purpose, programming language that provides code efficiency, elements of structured programming, and a rich set of operators. C is not a big language and is not designed for any one particular area of application. Its generality combined with its absence of restrictions, makes C a convenient and effective programming solution for a wide variety of software tasks. Many applications can be solved more easily and efficiently with C than with other more specialized languages.

The AVR Optimizing C Compiler is a complete implementation of the American National Standards Institute (ANSI) standard for the C language. Arduino is not a universal C compiler adapted for the Atmega 328 target. It is a ground-up implementation dedicated to generating extremely fast and compact code for the Atmega 328 microprocessor. Arduino provides you the flexibility of programming in C and the code efficiency and speed of assembly language. Since Arduino is a cross compiler, some aspects of the C programming language and standard libraries are altered or enhanced to address the peculiarities of an embedded target processor.

D. Supports for all AVR variants

The AVR Family is one of the fastest growing Microcontroller Architectures. More than 400 device variants from various silicon vendors are today available. New extended 8051 Devices, like the Atmega 328 architecture are dedicated for large application with several Mbytes code and data space. For optimum support of these different AVR variants, Arduino provides the several development tools that are listed in the table below. A new output file format (OMF2) allows direct support of up to 16MB code and data space. Arduino compiler is a variant of the arduino compiler that is design for the new Atmega 328 architecture.

E. Compiling with ATMEGA 328

This explains how to use AVR or compile C source files and discusses the control directives you may specify. These directives allow you to perform several functions.

For example:

- Direct Arduino to generate a listing file
- Control the information included in the object file
- Specify code optimization and memory models

F. Running Arduino from the command prompt

To invoke the Arduino compiler, enter at the command prompt. On this command line, you must include the name of the C source file to be compiled, as well as any other necessary control directives required to compile your source file.

Source file is the name of the source program you want to compile.

Directives are the directives you want to use to control the function of the compiler.

Command file is the name of a command input file that may contain source file and directives. A command file is used, when the invocation line gets complex and exceeds the limits of the Windows command prompt.

G. Embedded C

Micro controller program is written in Embedded C Language and It Is Compile and Converter D into Hex File Using Code Vision Software. The hex file is loaded into the micro controller for performing the operation.

H. Power supply unit

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators Starting with an AC voltage a steady DC voltage is obtained by rectifying the AC voltage then filtering to a DC level, and finally, regulating to obtain a desired fixed DC voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a DC voltage and provides a somewhat lower DC voltage, which remains the same even if the input DC voltage varies, or the output load connected to the DC voltage changes.

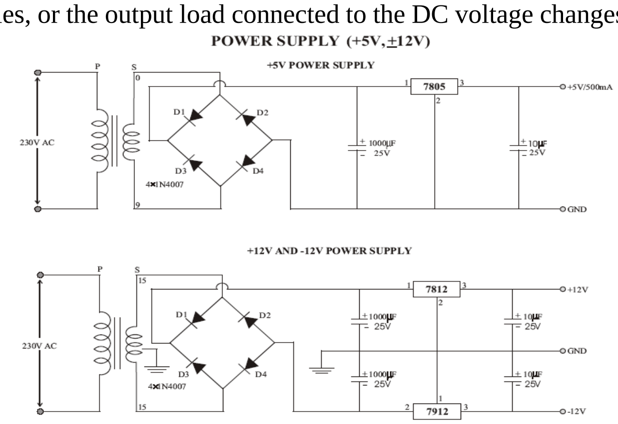

Fig. 2. Circuit diagram for Power Supply

I. IC voltage regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. Although the internal construction of the IC is somewhat different from that described for discrete voltage regulator circuits, the external operation is much the same. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage. A power supply can be built using a transformer connected to the AC supply line to step the AC voltage to desired amplitude, then rectifying that AC voltage, filtering with a capacitor and RC filter, if desired, and finally regulating the DC voltage using an IC regulator. The regulators can be selected for operation with load currents from hundreds of Millis amperes to tens of amperes, corresponding to power ratings from mill watts to tens of watts.

J. Three-terminal voltage regulators

Fig. shows the basic connection of a three-terminal voltage regulator IC to a load. The fixed voltage regulator has an unregulated DC input voltage, VI, applied to one input terminal, a regulated output DC voltage, Vo, from a second terminal, with the third terminal connected to ground The specifications also list the amount of output voltage change resulting from a change in load current (load regulation) or in input voltage (line regulation).

4. Circuit diagram

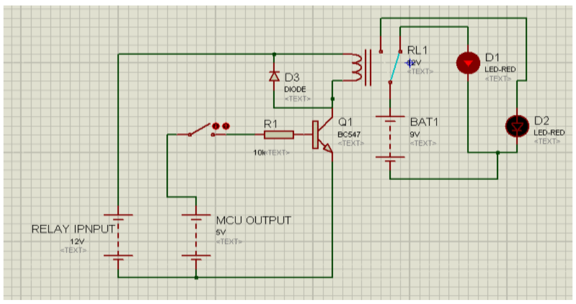

Fig. 3. Relay OFF

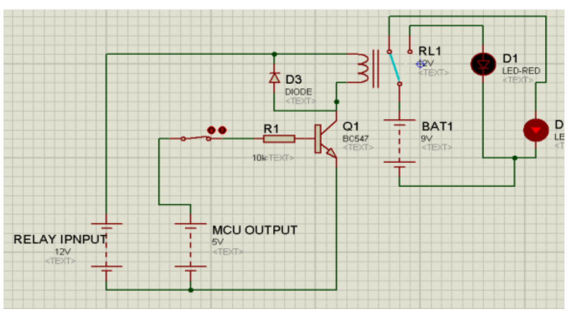

Fig. 4. Relay ON

5. Result

The generation of the human-like manipulation motions has been implemented and also tested successfully for the 4 degrees of freedom (DOF) arm of the humanoid robot. The presented approach does not consider the dynamics of the robot arm. This would be necessary to generate realistic velocity distribution for the manipulation motions. In this paper has reviewed the characteristics of the main mechanical structure and construction of a humanoid robotic arm. From this arm the exploration of afterwards will be a full body which is controlled by body switch. The final step of this robot is auto learner, in this stage this robot can learn automatically. The real/exact position and orientation of the arm can be obtained significantly large modifications of the joints θ1, θ2 and θ3. The assistive robotic arm will must be able to contribute most of the challenges in our daily life. However, the resulting configuration is not guaranteed to be human-like.

6. Conclusion

This report deals with a robotic arm whose objective is to imitate the movements of a human arm using accelerometers as sensors for the data acquisition of the natural arm movements. This method of control allows greater flexibility in controlling the robotic arm rather than using a controller where each actuator is controlled separately. The processing unit takes care of each actuator's control signal according to the inputs from accelerometer, in order to replicate the movements of the human arm to be designed and implemented.

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