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A Novel Design Approach of Industrial Application based Multipurpose Robot

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Abstract— *In the world of technology, there is a vital role for robotics to make human life better in many ways. The proposed Multi-Purpose Mobile Robot is a creative innovation which brings both complex technology and aesthetic design all together. This robot consists of a robot arm with 4 degrees of freedom. We are introducing the easiest form of control with a pendant that consists of a joystick and motion control with inbuilt inertial measurement sensors. In pendant mode, the robot calculates all of Its joint parameters using forward kinematics. The robot can also be controlled using simulation software. In simulation mode, user can either provide the desired angle of each joint, or coordinates of the end effector. If coordinates are provided, the robot calculates each joint parameters using Inverse kinematics. The software also creates the 3D simulation of the arm even before uploading the instructions to the robot so as to prevent most of the accidents and errors. To eliminate the main limitation of robot arms, locomotion ability is given to this multi-purpose mobile robot which makes it very helpful in various applications. The inbuilt Proximity sensors helps avoid any collisions ahead and finds the optimum route to maneuver. This makes this robot really multi-purpose, With the addition of an end effector which can be a universal gripper the robot can be used as a pick and place robot as well as a personal assistant for a physically challenged person also.*

Keywords— *Robot Arm, Robotics, Simulation, Locomotion of robot arm, Multi-purpose*

I. INTRODUCTION

Robotics is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing.

A 'mobile robot' is a robot that is capable of moving in the surrounding. Mobile robotics is usually considered to be a subfield of robotics and information engineering. Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robots can be "autonomous" which means they are capable of navigating an uncontrolled environment without the need for physical or electro- mechanical guidance devices. Alternatively, mobile robots can rely on guidance devices that allow them to travel a pre-defined navigation route in relatively controlled space. By contrast, industrial robots are usually more- or-less stationary, consisting of a jointed arm and gripper assembly, attached to a fixed surface. Mobile robots have become more commonplace in commercial and industrial settings. Hospitals have been using autonomous mobile robots to move materials for many years. Warehouses have installed mobile robotic systems to efficiently move materials from stocking shelves to order fulfillment zones. Mobile robots are also a major focus of current research and almost every major university has one or more labs that focus on mobile robot research. Mobile robots are also found in industrial, military and security settings. The components of a mobile robot are a controller, sensors, actuators and power system. The controller is generally a microprocessor, embedded microcontroller or a personal computer. The sensors used are dependent upon the requirements of the robot. The requirements could be dead reckoning, tactile and proximity sensing, triangulation ranging, collision avoidance, position location and other specific applications. Actuators usually refer to the motors that move the robot can be wheeled or legged. To power a mobile robot usually we use DC power supply instead of AC.

Robotics have emerged and advanced at an exponential rate since the initiation of the 20th century. These robots function in potentially hazardous settings in proximity to biological dangers. It enables the betterment of physically challenged people's lives. Due to assistive technology people with disabilities have an opportunity of a more positive and easygoing lifestyle, with an increase in social participation, security and control, and a greater chance to reduce institutional costs without significantly increasing household expenses. The proposed multi-purpose mobile robot arm can be used as a device that replaces a missing body part or it can be used to replace a person in some cases too. The mobile robot allows the user to control it using a joystick or by other adaptive methods. A robot arm with 5 degrees of freedom is mounted on a base which can be moved around the workspace as the users needs. The multi-purpose mobile robot is made in a compact design which makes it human friendly more than ever.

II. LITERATURE REVIEW

A literature review was conducted to investigate the history and achievements of application of robotics in arm. The source investigated involves the following observations

Aakash K Sancheti [1] propose idea is to change the perception of remote controls for actuating manually operated Robotic-Arm. Well, this paper presents a thought and a way to

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eradicate the buttons, joysticks and replace them with some other more intuitive technique, that is, controlling the complete Robotic Arm by the operator's hand movement or motion or gesture. In this paper the completely electronic (i.e. without mechanical sensors) way of achieving the above stated goal is discussed. This is achieved by using MEMSACCELEROMETER technology (that is used in smart phones for tilt sensing), showing the diversity of the application of the same technology. Index Terms- 6-DOF, MEMS, MEMS

Saifulla Khan [2] propose human inaccessible areas such as high radiation exposure in power plants and defenses the efficiency of work flow is limited. This paper proposes an idea about a low-cost microcontroller based robotic arm. This robotic arm is implemented by controlling the gesture using accelerometer and microcontroller. This arm will help in doing functions such as holding objects, and wireless remote controlled operating of devices in the field where more radiation hazards are present. This method can be improved by using 3-D printing of an arm for prosthetic replacements.

Masturi Binti Muhammed [3] studied about MR-999-E is a robotic arm that has five separate movements to grab or release, lift or lower, rotate wrist and pivot sideways controlled by five servo motors. For the time being it has been used as a trainer in the university lab. A physical wire from the controller to the interface of the robotic arm contributes its major movements. This paper is to describe a new approach from wired to wireless technology added with Graphical user Interface (GUI) application to make it more user-friendly. The transmitter will be connected to the computer whereas the receiver will be connected to the robotic arm interface. In the GUI, the robotic arm is modeled using SolidWork 2005 software and implemented into Visual Basic environment. As a result, real-time and simultaneous movements from simulation to actual environment will be performed. All the movements have been calibrated to ensure that the transmission of data is correct. MR-999-E wireless robotic arm is one of the products that employ wireless technology to support applications such as remote monitoring and surgery.

III. PROBLEM IDENTIFICATION

Existing and conventional robot arms has no correspondence with humans. Robot arms were kept inside a cage as they were not designed to work alongside humans and all the existing robot arms will look scary to humans because of the same reason. Robot arms were always immobile and large in size which made them not suitable for day to day usages. Due to the excessive size and weight all the existing robot arms had so much limitations. They required a very frequent monitoring and maintenance.

A skilled labor was mandatory to operate the robot arm because there wasn't any user friendly interfaces were available, The person who is operating the robot arm should have good knowledge in programming and electronics as well as in pneumatics too. This causes various troubles and hazards because of the complexity in controlling a robot arm.

As mentioned above the only possible way to control a robotic arm was through complex programming which made it impossible to control a robotic arm with a joystick and implement gesture control in it. Due to the need of pneumatic systems and other heavy and high energy consuming actuators the operation of a robotic arm was always a nightmare for a common man. Due to the presence of all these heavy components the design of a robot arm was never that much aesthetic. Specific robot arms were used for performing specific tasks. Once a robot arm is programmed to do a specific task it could not do any other operation rather than that. Because of this for doing each operations different arms should be there for that and this made people to think like the implementation of robot arm is no longer feasible.

IV. METHODOLOGY

Fig 3.1 shows the methodology adopted in development of the project. The proposed system is a robot that is wirelessly controlled and has unlimited application in the robotics field and can improve accuracy, reliability, and reduce the time consumption. It has unlimited possibilities of expanding the capabilities by adding better and advanced hardware components that can improve the capabilities like memory, Implementation of Virtual reality and Augmented reality , Mapping of floor, etc.

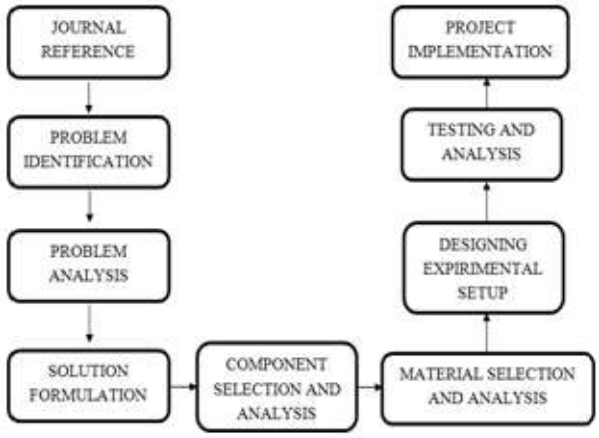

Figure 1 Methodology

Initially a number of journals related to the project were referred to in order to acquire enough data related to the problems faced in the pharmacological domain and the technological advancements up till date. The next step is to identify the drawbacks of the pre-existing conventional pharmacological systems or also referred to as Problem identification. The identified drawbacks and demerits were analysed to determine the root of the cause and these root causes were determined and solutions were formulated. Next step is to list the components that are required to implement the project, their analysis, and selection. Similarly the raw materials required were also analysed and selected.

Next step is to design the experimental setup in 2D or 3D

model and their testing and analysis is to be conducted. Any failure will be noticed and they will be rectified through study and analysis. Once the setup is perfected the implementation of the project is executed.

V.DESIGN SOLUTION

Application of locomotion is the most effective methodology that can be employed as a solution to the challenges faced by the conventional Robot arms. Robot arm has the ability to move around an area and perform various tasks as the user demands it. Robot gets sleek and compact in design and hence becomes more user friendly. Gesture control can be implemented and the controlling can be made easier than ever. With the help of locomotion the robot arm could replace a human or a body part of human in some cases. The arm can be used to perform dangerous operations which requires high precision and accuracy as well as it could be used to assist a partially paralyzed or differently abled person.

A. Communication

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega168 and ATmega328 provide UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino software) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the FTDI chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows for serial communication on any of the Nano's digital pins.

The ATmega168 and ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. To use the SPI communication, please see the ATmega168 or ATmega328 datasheet.

B. Programming

The Arduino Nano can be programmed with the Arduino software (download). Select "Arduino Diecimila, Duemilanove, or Nano w/ ATmega168" or "Arduino Duemilanove or Nano w/ ATmega328" from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega168 or ATmega328 on the Arduino Nano comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header;

C. Automatic (Software) Reset

Rather then requiring a physical press of the reset button before an upload, the Arduino Nano is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the FT232RL is connected to the reset line of the ATmega168 or ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Nano is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Nano. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data

Block Diagram of Robot

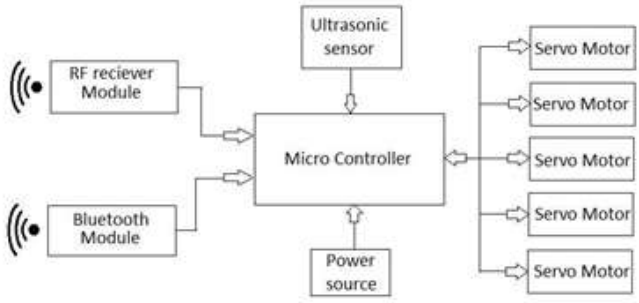

Fig 2 Block diagram of Robot Circuit

Block Diagram Of Pendant

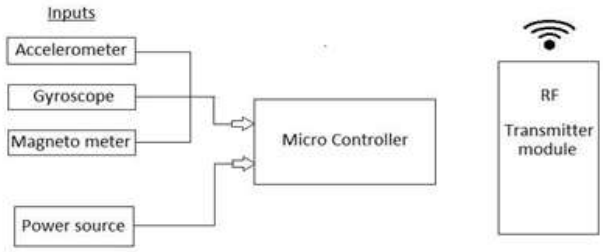

Fig 3.Block diagram of Pendant Circuit

VI. ROJECT MODEL

The design shown fig 4 shows the CAD representation of the robot. The model is an exact copy of the original prototype.

Fig 4. CAD drawing

Figure 5 shows the dimensional specifications of the project design. All dimensions are in mm.

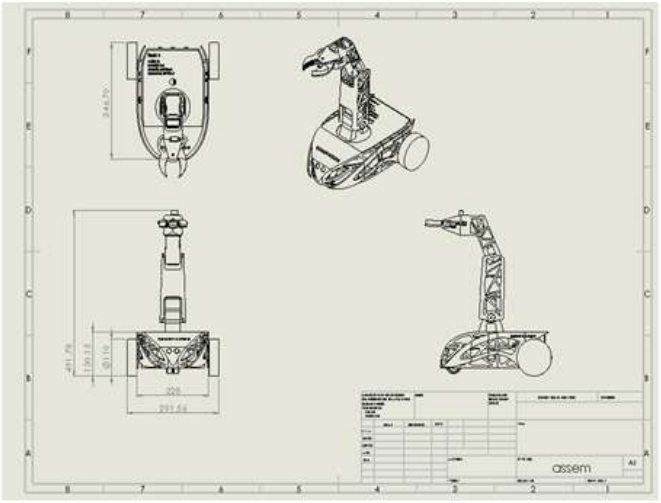

Fig 5 Dimensional Drawings of Front view, Left view and Top View

VII. CONCLUSION

1. It is working wonders in terms of increasing efficiencies all around. Possibly the greatest benefit is the implementation of Mobility, More human friendly than ever, and the ease of operating this robot arm.

2. Robotics has brought about a great impact on the error rate reduction soon after their application.

3. There has been effective and seamless assistance to physically challenged people.

4. The need of an extra labor to take care of the physically challenged person is reduced drastically by applying robotics.

5. The need of skilled labor for operating a robot arm alone is no more a concern.

6. There is a general shift toward that, which means costs will be going down in time which means robotics will be employed widely in near future.

7. Thus the replacement of human or a human body part such as hand can be used as a replica of that human.

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