DESIGN AND DEVELOPMENT OF ROBOTIC GRIPPER

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Abstract: *Today, technology is developing in the same direction in line with rapidly increasing human needs. The work done to meet these needs makes life easier every day, and these studies are concentrated in robotic arm studies. Robot arms work with an outside user or by performing predetermined commands. Nowadays, the most developed field of robot arms in every field is the industry and medicine sector. Designed and realized in the paper, the robot gripper has the ability to move in 1 axis directions with 2 servo motors. Through the servo motor and gripper can take the desired material from one place and carry it to another place, and also mix it with the material it receives. While doing this, robot control is provided by connecting to the android application via Bluetooth module connected to Arduino Nano microcontroller.*

Keywords *– Actuation Mechanism, Two fingered gripper.*

I.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. A robotic arm is a robot manipulator, usually programmable, with similar functions to a human arm. 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 business end of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand.

The end effectors can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy. The robotic arm can be fixed or mobile and can be designed for industrial or home applications.

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.

II. LITERATURE REVIEW

[1] Humans have remarkable abilities in controlling their limbs in a fashion that outperforms most artificial systems in terms of versatility, compliance and energy efficiency. The fact that biological motor systems suffer from significant noise, sensory delays and other sources of stochasticity (Faisal et al. 2008) makes their performance even more impressive.

[2] Therefore, it comes as no surprise that biological motor control is often used as a benchmark for robotic systems. On the one hand, biological motor control characteristics are a result of the inherent biophysical properties of human limbs, and on the other hand, they are achieved through a framework of learning and adaptation processes (Wolpert et al. 1995; Kawato 1999; Davidson and Wolpert 2005).

[3] These concepts can be transferred to robotic systems by (i) developing appropriate anthropomorphic hardware and (ii) by employing learning mechanisms that support motor control in the presence of noise and perturbations (Mitrovic et al. 2008). In this paper, we focus on issues related to adaptive motor control of antagonistically actuated robots. Antagonistic actuator designs are based on the biological principle of opposing muscle pairs.

[4] Therefore, the joint torque motors, for example, of a robotic arm are replaced by opposing actuators, typically using mechanical springs (Pratt and Williamson 1995). Such series elastic actuators (SEA) have had increasing attention in the last few decades (Vanderborght et al. 2009) as they provide several beneficial properties over classic joint torque actuated systems

III.PROBLEM IDENTIFICATION

A Mechanical gripper is end effector that uses mechanical fingers actuated by a mechanism to grasp an object. The finger , sometimes called jaws, are the appendages of the grippers that actually make contact with the object .The fingers are either attached to the mechanism or an integral part of the mechanism If the fingers are of the attachable type , then they can be detached and replaced. The use of replaceable finger allows for wear and inter-changeability. Different sets of finger allows for use with the same gripper mechanism can be designed to accommodate different part models. The function of the gripper mechanism is to translate some form of power input into the grasping action of the fingers against the part. The power input is supplied from the robot and can be pneumatic, electric, mechanical, or hydraulic. In this paper mainly focused on rack and pinion actuation mechanism, gripper arrangement related with two motor is used to grasp and un grasp the object.

IV METHODOLOGY

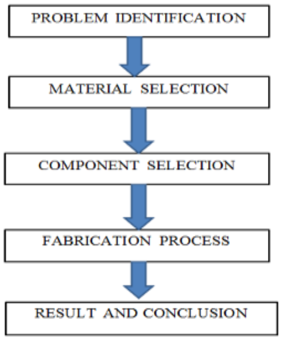


Fig. 1. Methodology

V COMPONENT DESCRIPTION

5.1. Servo motor

Servo motors are a type of electromechanical actuators that do not rotate continuously like DC/AC or stepper motors; rather, they are used to position and hold some object. They are used where continuous rotation is not required so they are not used to drive wheels (unless a servo is modified). In contrast they are used where something is needed to move to particular position and then stopped and hold there. Most common use is to position the rudder of aircrafts and boats etc. The servo can be commanded to rotate to a particular angle and then hold its position there. Servos also employ a feedback mechanism, so it can sense an error in its positioning and correct it. This is called servomechanism. Say if you ask servo to go and lock itself to 30 degrees and then try to rotate it with your hand, the servo will try hard and its best to overcome the force and keep servo locked in its specified angle. Controlling a servo is easy by using a microcontroller, no external driver like h-bridge etc. are required. Just a control signal is needed to be feed to the servo to position it in any specified angle. The frequency of the control signal is 50 Hz and the width of positive pulse controls the angle

Fig. 2 Servo Motor

5.2 ARDUINO Board

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

Fig.3 Arduino Board

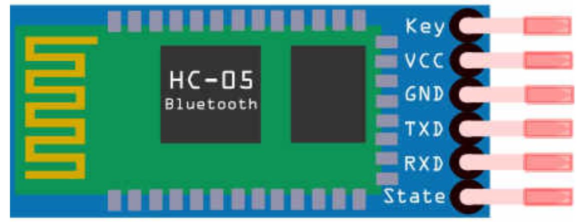


Fig 4 Bluetooth HC 05

5.3 Bluetooth

HC05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

It uses CSR Blue core 04 External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).The Bluetooth module HC-05 is a master/slave module. By default the factory setting is slave. The Role of the module (Master or Slave) can be configured only by at commands. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

5.4. Power Supply

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.

A block diagram containing the parts of a typical power supply and the voltage at various points in the unit is shown fig. The ac voltage, typically 120 V rms, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage.

This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, or the load connected to the output dc voltage changes.

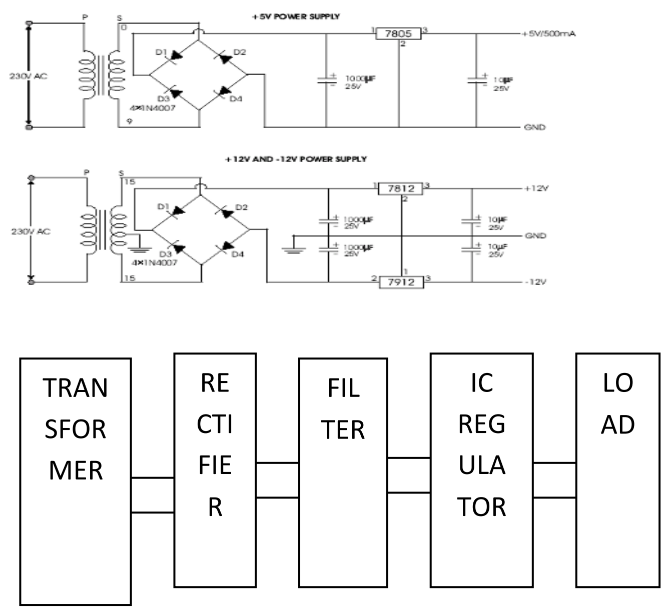


Fig 5 Power Supply

5.5. Gripper

Robot mechanical grippers and its actuating mechanisms can be classified into several methods. The first method is based on the type of finger movement. During this arrangement, the opening and closing of the fingers can be actuated by either pivoting or linear movement.

5.1 Pivoting movement:

In this motion, the rotation of fingers is concerned with the fixed pivot points of the gripper for providing open and close actions. It uses the linkage mechanism for achieving this movement.

5.2 Gear and rack actuation:

For this actuation, the gear and rack are connected with a *piston*, which provides linear-type movement. The two partial pinion gears are driven when the rack is moved. As it is linked with gripper, the opening and closing of fingers are accomplished.

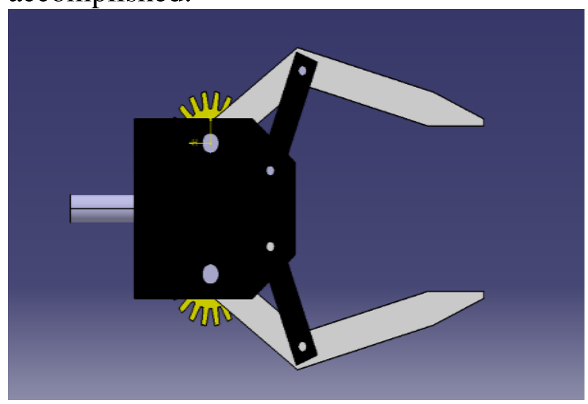


Fig.6. Design of rack and pinion gripper

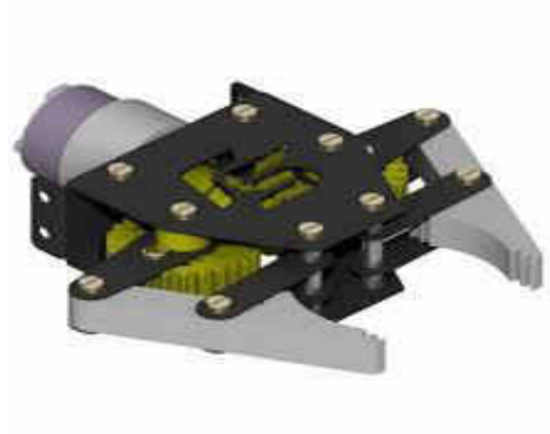


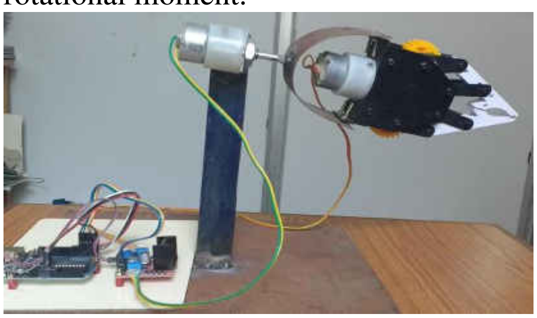
Fig 7 Fabricated Gripper

VI WORKING METHODOLOGY

In this paper we designed and developed the two fingered robotic gripper by using rack and pinion mechanism. In this we used two motors for functioning of the gripper. One motor is used for the rotation purpose of the gripper hand and another one is used to grasp and ungrasp the fingers of the robotic gripper.

The motor are operated with the help of batteries. Each motor is connected with an individual battery. The motor is controlled by using switches. When a power supply is given to the motor it will rotate and as it is connected with the robot gripper it will help for the movement of the gripper hand.

When it rotates clockwise the gripper hand will grasp a object where as it rotates in anticlockwise it will un grasp an object and as like this the motor which connected at the end of the gripper hand, it will helps to rotates the gripper hand in order to possess a rotational moment.



VII CONCLUSION

The objectives of this project has been achieved which was developing the hardware and software for an accelerometer controlled robotic arm. From observation that has been made, it clearly shows that its movement is precise, accurate, and is easy to control and user friendly to use.

The robotic arm has been developed successfully as the movement of the robot can be controlled precisely. This robotic arm control method is expected to overcome the problem such as placing or picking object that away from the user, pick and place hazardous object in a very fast and easy manner.

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