Design and Fabrication of Humanoid Robot

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Abstract

This thesis paper analyzes the flexibility of humanoid robot structure design based on design parameters of degree of freedoms and joint angle range characteristic. As a result it helps to identify elements that provide flexibility for humanoid robots to attain human-like motion. Description and correlation of physical structure flexibility between human and humanoid robot to perform motion is presented to clarify the elements.This analysis utilized the joint structure design, configuration of degree of freedoms and joint rotation range of an 11-dof humanoid robot. Experiments utilizing this robot were conducted, with results indicates effective design parameters to attain flexibility in human-like motion. For this reason, only a small number of research groups have the ability to create full-sized humanoid robots that can walk and run.

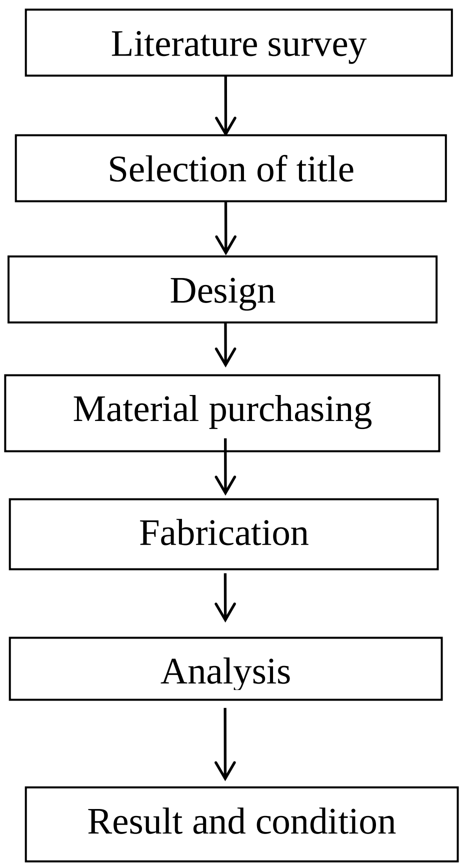
Keywords: Humanoid robot, Design parameter, Degree of freedom, Walk and run

I. INTRODUCTION

A robot is a mechanical or virtual agent, usually an electro-mechanicalmachine that is guided by a computer program or electronic circuitry.

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. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. These robots have also createda newer branch of robotics: Soft robotics.

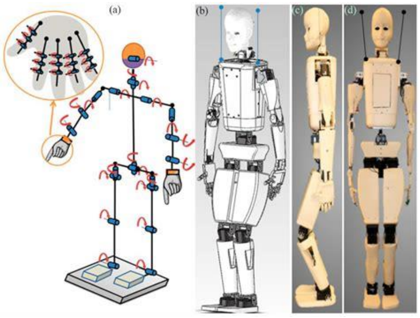
II. RESEARCH METHODOLOGY



III. RESULT AND DISCUSSION

3D modeling

Humanoid robot



Design analysis:

Mass Property

Material: Aluminum sheet

Mass = 4kilo grams

Total weld mass = 0 grams

Volume = 6.46e + 005 cubic millimeters

Surface area = 3.89e + 005 square millimeters

Center of mass: (millimeters)

X = −1.37

Y = −89.2

Z = −24.8

Principal axes of inertia and principal moments of inertia: (grams × square millimeters)

Taken at the center of mass.

Tx = (−0.00736,0.999,−0.036) Tx = 4.44e +006

Ty = (−0.999,−0.00601,0.0373) Ty = 1.36e +007

Tz = (0.037,0.0363,0.999) Tz = 1.77e +007

Moments of inertia: (grams × square millimeters)

Taken at the center of mass and aligned with the output coordinate system.

Txx = 1.36e +007Txy = −7.3e +004Txx = −1.48e +005

Tyx = −7.3e +004Tyy = 4.46e +006Tyy = −4.78e +005

Tzx = −1.48e +005Tzy = −4.78e +005Tzy = 1.77e +007

Moments of inertia: (grams × square millimeters)

Taken at the output coordinate system.

Txx = 2.19e +007Txy = 4.45e +004Txx = −1.15e +005

Tyx = 4.45e +004Tyy = 5.05e +006Tyx = 1.65e +006

Tzx = −1.18e +005Tzy = 1.65e +006Tzx = 2.53e +007

MAIN PARTS

1.Arduino uno

2.Arduino mega

3.Servo motor

4.HC06 Bluetooth module

5.DC motor

6.Wheel

7.Deep grove ball Bearing

8.SD module

9.Wifi camera

10.Speaker

1.Arduino uno:

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

2.Arduino mega

The Arduino MEGA 2560 is designed for projects that require more I/O llines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities maintaining the simplicity and effectiveness of the Arduino platform. This document explains how to connect your Mega2560 board to the computer and upload your first sketch.

3.Servo motor

It is tiny and lightweight with high output power. This servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos.It comes with a 3 horns (arms) and hardware.

Fig6.3.3

Specification

- Operating voltage: 4.8 V (~5V)
- Operating speed: 0.1 s/60 degree
- Stall torque: 1.8 kgf·cm
- Dead band width: 10 µs
- Temperature range: 0 ºC – 55 ºC

4.HC 06 Bluetooth module

This Bluetooth module can easily achieve serial wireless data transmission. Its operating frequency is among the most popular 2.4GHz ISM frequency band (i.e. Industrial, scientific and medical). It adopts Bluetooth 2.0+EDR standard. In Bluetooth 2.0, signal transmit time of different devices stands at a 0.5 seconds interval so that the workload of bluetooth chip can be reduced substantially and more sleeping time can be saved for bluetooth. This module is set with serial interface, which is easy to use and simplifies the overall design/development cycle.

Fig6.3.4

5.DC motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.Its toque range is 4kg.

Fig6.3.5

6.Wheel

In its primitive form, a wheel is a circular block of a hard and durable material at whose center has been bored a circular hole through which is placed an axlebearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, thereby making together one of the six simple machines.

Fig6.3.6
Fig6.3.7

7.SD Module

The SD Card Module is a simple solution for transferring data to and from a standard SD card. The pinout is directly compatible with Arduino, but can also be used with other microcontrollers. This module has SPI interface which is compatible with any sd card and it use 5V or 3.3V power supply which is compatible with Arduino UNO/Mega.SD module has various applications such as data logger, audio, video, graphics.

FABRICATION
Making hand:

Making face:

Fixing bearing of the neck:

Finishing of fabrication :

After painting:

COST OF THE PROJECT

S.NO	PARTS AND WORK	COST
1	Aluminium sheet-4kg	1400
2	Plastic	100
3	Servo motor X 11	2200
4	DC motor X 2	450
5	Arduino mega	900
6	Arduino uno	450
7	Wifi camera	1950
8	Jumper wire	400
9	SD module	160
10	Hc06 bluetooth module X 2	640
11	Speaker	70
12	Wheel	100
13	Caster wheel	100
14	Power bank	750
15	Bearing	60
16	Paint	600
17	Driller,Sheet cutter(rent)	600
18	Other(mask,bolt, nut etc)	1000
	TOTAL	11930

IV. FUTURE SCOPE

The main objective of the humanoid robot is the technical feasibility. We work in the thesis to improve the technical ability of the robot. At present our humanoid robot has walking, sensing and visualization capabilities. In future we will improve the capabilities of the humanoid robot in the following way:

Walking:

At present our robot moves in forward direction. In future, we are planning to move the robot in backward direction also. In rough surface our robot will withstand and move frequently without difficulty. Our humanoid robot will work efficiently at any environment.

Manipulation:

It's contain all systems necessary for the direct interaction with the surrounding environment of the robot. This includes arms and hand of the robot. We will improve the gripping algorithm and manipulation planners.

Power supply:

At present, we are using dc power supply with the help of adapter which converts AC to DC power supply. But a humanoid robot can make sense if he is a mobile system with independent power supply. That is why he needs an internal power supply. This power source will enable it a long duration work period. For this reason the requirement of internal power source is high. Our future plan is to use battery as power source which is capable of meet the required demand.

Communication:

Humanoid robots need to communicate with real human at work. The user may not be a specialist at robotics. So it need to communicate in natural language with the people around him. And also understand the commands given and respond in natural language. Our future plan is to modify the humanoid robot to understand voice command and respond in natural language.

Perception:

This is the ability to sense the surrounding of the robot. A humanoid robot moving in an environments with real human must have a precise idea of the world around him. Therefore he needs to have good external sensor. Optical cameras in often stereo camera systems are preferred today because of their flexibility. High quality of perception is needed because it is not acceptable if the robot confuses a crawling child with stair step. In future our plan is to use Optical cameras to improve perception of the robot.

Another plan is to make two humanoid robots which will play football. By using these robots, we will participate in the different international competitions.

V. CONCLUSION

Human evolution to bipedalism is an option for developing intelligent machines. That way, some progress on walking robotics was explained with the emphasis on the results in the few research groups around the world. Even though walking robotics is an important and attractive research area in robotics, not enough applications have been made yet. For the future of walking bipedal, considering how to improve this situation will be necessary. This was briefly discussed and reconsideration of the goal of walking robotics research was pointed out for the improvement of the situation.

In order to reduce power consumption and increase motion stability, the weight and height are reduced throughout the construction of humanoid robot prototypes. The degrees of freedom (DOFs) are the minimum for high dexterity by using strong, light materials, small electronic but powerful devices, high torque motors, powerful modelling and control algorithms.

The main goal of this work was to develop a bipedal walking method which allows a full-sized humanoid robot to walk. Although there have been many approaches for bipedal walking methods including ZMP method, most of them require the knowledge of contact forces at the feet or forces transmitted through the ankles. Either approach requires developers not only to install sensitive sensors on the robot but also to process and interpret the signals properly. Because of these difficulties, the development of a full-sized humanoid robot has been considered one of the most challenging tasks in the field of robotics.

VI. REFERENCES

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