International Journal of Research in Engineering and Applied Sciences(IJREAS)
Available online at http://euroasiapub.org/journals.php
Vol. 7 Issue 1, January-2017, pp. 207~213
ISSN (O): 2249-3905, ISSN(P): 2349-6525 | Impact Factor: 6.573 | Thomson Reuters Researcher ID: L-5236-2015

A STUDY ON MECHANICAL DESIGN OF HUMAN ROBOTS

Pawan Kumar
Department of Mechanical Engineering, Ch. Devi Lal State Institute of Engineering & Technology, Panniwala Mota, Sirsa, Haryana, INDIA

ABSTRACT

Many aspects of modern life involve the use of intelligent machines capable of operating under dynamic interaction with its environment. The field of biped locomotion is representative of this interest concerning human-like robots. The main reasons for designing the humanoid robots as service and maintenance machines is to help us humans enjoy life and to relieve us of many of the mundane noncreative tasks which we all face every day. Recently, significant progress has been made in the design of a hardware platform of a humanoid robot and control of humanoid robots, particularly in the realization of dynamic walking in several full-body humanoids It is as obvious as interesting that anthropomorphic biped robots are potentially capable to effectively move in all unstructured environments where humans do.

KEYWORDS:

Robot, Machine, Human

INTRODUCTION

In order to accomplish high and complex demands, which they have as service machines, humanoid robots must incorporate the intelligent capabilities. Intelligent humanoid robots are functionally oriented devices built to perform sets of tasks in-stead of humans, as autonomous systems capable of extracting information from its environment and using knowledge about its world and intelligence of their duties and proper governing capabilities. Human operator can transfer to the robot his knowledge, experience and skill in advance, to make it capable of solving complex tasks. The current paper highlights the mechanical design for human robots.

Naturally, the first approach to making humanoid robots more intelligent was the integration of sophisticated sensor systems. However, today's sensor products are still very limited in interactivity and adaptability to changing environments. On the other hand, in to design robots and systems that best adapt to their environment, research includes investigations in the field of mechanical robot design, environment perception systems and embedded intelligent control. Also, in the case when the robot performs in an unknown environment, the previous knowledge may not be sufficient. Hence, the robot has to adapt to the environment and to be capable of acquiring new knowledge through the process of learning.

Connectionist theory (NN - neural networks), fuzzy logic (FL), and theory of evolutionary computation (GA - genetic algorithms), are of great importance in the development of intelligent humanoid robot control algorithms. Each of the proposed paradigms has their own merits and drawbacks. To overcome their drawbacks, certain integration and synthesis of hybrid techniques (symbiotic intelligence) are important for efficient application in humanoid robotics.

There are various types of robots available, each produced for different purposes and for different platforms. They can be developed for the purpose of domestic assists, industrial employs, investigations, entertainment etc. This family of robots can be classified by several different methods which based on their applications, kinematics structure, shape of workspace, operating method, type of controller, type of technology, arm configuration, type of locomotion etc. Using the method based on locomotion, robots can be classified into two basic classes: (I) Stationary robot, and (II) Mobile robot.

Stationary robot

The stationary robot is not really motionless, but its motions are restricted to a small boundary. It includes robotics arms which can be moves around the global axis. The industrial robots are the examples of stationary robots.

Mobile robot

The mobile robot is a movable robotic system which can move from one place to other place within an environment. The autonomous guided vehicles, humanoid robots are the examples of mobile robots.

MECHANICAL DESIGN OF HUMAN ROBOTS

i) Connectionist Control Algorithms in Humanoid Robotics

Recently, some researchers have begun considering the use of neural networks for control of humanoid walking. The various type of neural networks are used for gait synthesis and control design of humanoid robot as it is multilayer perceptions, CMAC networks, fuzzy-neural network, RBF net-works or Hopfield networks, that are trained by supervised or unsupervised (reinforcement) learning methods.

The neural networks were used as efficient tool for solution of synthesis and off-line and on-line adaptation of biped gait as well as for solution the control problem of static and dynamic balance during process of walking and running on terrain with different environment characteristics.

More recently Miller has developed a hierarchical controller which combines simple gait oscillators, classical feed-back control techniques and neural network learning and does not require detailed equations of the dynamics of walking. The emphasis is on the real-time control studies using an experimental ten axis biped robot with foot force sensors.

There are 3 different CMAC neural networks for humanoid posture control. The Front/Back Balance CMAC neural network was used to provide for front/back balance during standing, swaying and walking. The training of this network is realized using data from foot sensors.

The second CMAC neural network is used for Right/Left Balance in order to predict the correct knee ex-tension required achieving sufficient lateral momentum for lifting the corresponding foot for the desired length of time.

The training of this network is realized using temporal difference method based on error between desired and real time of foot rising. The third CMAC network is used to learn kinematically consistent robot postures. In this case, training is also realized by data from foot sensors.

The results indicate that experimental biped was able to learn the closed chain kinematics necessary to shift body weight from side-to-side while maintaining good foot contact. Also it was able to learn the quasistatic balance required to avoid falling forward or backward while shifting body weight from side-to-side at different speeds. It was able to learn the dynamic balance in order to lift a foot off the floor for a desired length of time and different initial conditions.

The control structure on high-level control level includes 7 components: gait generator, simple kinematics block and 5 CMAC controllers. The CMAC neural network are used for compensation of right and left lift lean angle correction, reactive front-back offset, right-left lean correction, right and left ankle - y correction and front-back lean correction. Training of neural network is realized through process of temporal difference learning using information about ZMP from robot foot sensors. The control structure on the lower control level include reactive lean angle control together with PID controller. The experimental results indicate that UNH biped robot can walk with forward velocities of the range (21cm/min - 72cm/min) with sideways leaning speed of the range (3.6 o/s - 12.5 o/s).

ii) Fuzzy control algorithms in humanoid robotics

An inconvenience of the proposed strategy is the absence of functional preparing information. Right now there is no numerical criticism showing signal, just evaluative input signal exists (disappointment or achievement), precisely when the biped robot falls (or nearly tumbles) down. Thus, it is a normal fortification learning issue. The dynamic parity information is collected through fortification adapting continually improving the stride during strolling. Precisely, it is fluffy fortification discovering that utilizes fluffy basic sign. For human biped walk, it is ordinary to utilize semantic basic signals, for example, "close tumble down", "nearly achievement", "more slow", "quicker", and so forth. Right now, step synthesizer with support learning depends on an altered GARIC (Generalized Approximate Reasoning for Intelligent Control) strategy.

This engineering of step synthesizer comprises of three parts: activity determination organize (ASN), activity assessment arrange (AEN), and stochastic activity modifier (SAM) (Figure 2).

The ASM maps a state vector into a prescribed activity utilizing fluffy induction. The preparation of ASN is accomplished similarly as with standard neural systems utilizing blunder sign of outer support. The AEN maps a state vector and a disappointment signal into a scalar score which shows the state goodness. It is additionally used to create interior support. The SAM utilizes both prescribed activity and inward support to create an ideal stride for the biped. The support signal is produced dependent on the contrast between wanted ZMP and genuine ZMP in the x-y plane. In all cases, this control structure remembers for line adjustment of step synthesizer and neighborhood PID controllers. The methodology is checked utilizing reproduction tests. In the recreation examines, just even landscape for biped strolling is considered, thus the methodology ought to be confirmed for unpredictable and inclined.

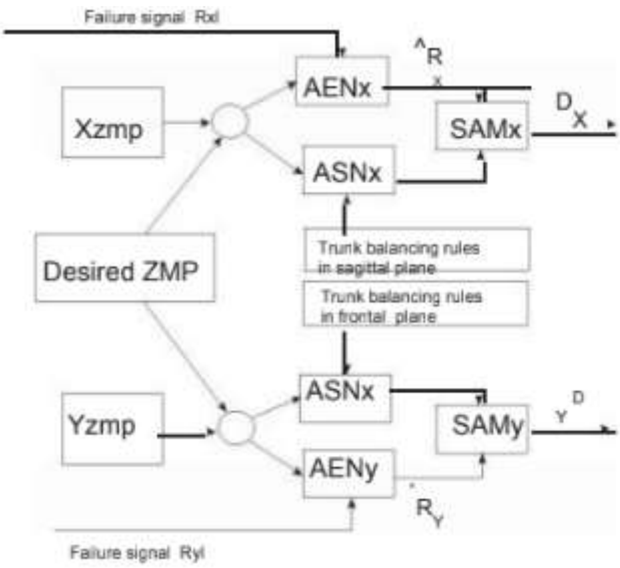

Figure 2: The architecture of the reinforcement learning based gat synthesizer

iii) Genetic Approach in Humanoid Robotics

With movement robots, GA can be proficiently applied for various leveled direction age of normal movement of biped utilizing vitality advancement. The various leveled direction age technique comprises of two layers, one is the GA level which limits the absolute vitality all things considered and the other is the transformative programming (EP) layer which streamlines the added design of biped movement robots.

The chromosome in the EP level speaks to the introduced setup communicated by 12 state factors (edges) of the biped. Likewise, a chromosome in a GA level comprises of two sections, the first of them speaking to the arrangement of introduced designs, while the subsequent part incorporates a piece which speaks to the viability of setup (0 or 1).

The procedure runs in cyclic methodology through the use of change and determination at the EP level, move of created inserted design into the GA level, and complete development process through hybrid, transformation, assessment and choice at the GA level. The wellness work at the GA level is associated with the improvement of absolute robot vitality so as to guarantee the regular development of biped. The wellness work additionally contains a few imperatives identified with the robot movement. The conclusive outcome speaks to the streamlined direction like regular human strolling that was shown by try.

iv) Hybrid Intelligent Approaches in Humanoid Robotics

The preparation calculation is back proliferation through time. The linearized backwards biped model gives the mistake signs to backpropagation through the controller at control time moments. For the given prespecified limitations, for example, the progression length, crossing freedom, and strolling speed, the control plan can produce the step that fulfills all referenced requirements.

GA has been proficiently applied in mechanical neuro approaches, as on account of the neuro-GA controller for outwardly guided swing movement of a biped with 16 DOFs.

The point of this robot task is learning of swing movement by neural system utilizing visual data from a virtual workplace. In-stead of a genuine biped, virtual workplace is utilized for quickening of the learning procedure. As we move the taking in process from the virtual condition to the genuine robot, the distinction existing between these two frameworks are killed by speculation capacities of the neural system.

The point of learning for outwardly guided swing movement is expanding the swing sufficiency by handy difference in the gravity focal point of the biped robot toward swing sweep, brought about by unique difference in nature perceived by the vision sensor. The contribution to the system speaks to sensor data from the vision sensor, while the yield of the neural system are the knee edges of the biped.

GA streamlines the three arrangements of the weighting variables of this 4-layer neural system. At the yield of the system, there are limiters of precise speeds so as to maintain a strategic distance from outrageous changes of joint points. The genotype is spoken to by a succession of weighting factors. The quantity of people in the underlying populace is 200. The wellness work is spoken to by the tallness of the focal point of gravity in the underlying and last posture. The development reenactment tests are terminated when the quantity of rotations in ages arrives at 50 variations. The outcomes show proficient learning of swing movement through progressive age that is confirmed through speculation investigates the genuine robot biped.

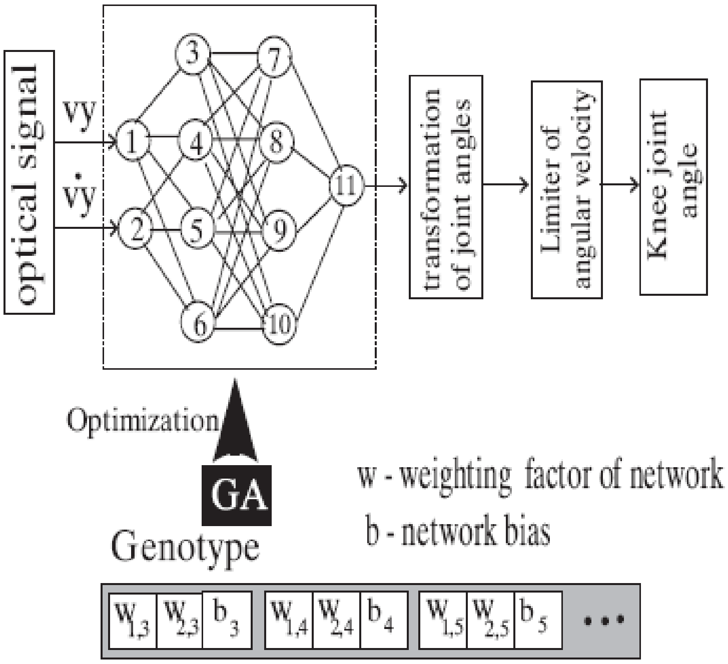

Figure 3: Neuro-GA approach for optimization

CONCLUSION

This paper presents the design and development of human robot for light material lifting application. The robotic arm is drafted using computer aided design software, Autocad and fabrication with advance technology, 3D-printing to save cost and time. The robotic arm is made up of ABS (Acrylonitrile Butadiene Styrene) and one of the linkages between the body and motor is made up of PLA (Polylactic Acid). During the 3D printing process, we faced a problem in printing an overhanging part which strongly affected the joining part by causing a severe defect. Mesh mixer software which can generate support automatically at the overhanging part thus a satisfied product is obtained.

REFERENCES

- Gandek, S. Keller, D. Razavi, R. Sanson-Fisher, M. Sullivan, S. Wood-Dauphinee, A. Wagner, and J. E. Ware Jr. International quality of life assessment (iqola) project. Quality of Life Research, 1(5):349–351, Dec 2014.
- P. Aigner and B. Mc Carragher. Shared control framework applied to a robotic aid for the blind. Control Systems Magazine, IEEE, 19(2):40–46, April 2014.
- I. Asimov. I, Robot. Doubleday, 2015.
- I. Asimov. Bicentennial Man. Ballantine Books, 2014.
- H. Asoh, S. Hayamizu, I. Hara, Y. Motomura, S. Akaho, and T. Matsui. Socially embedded learning of the office-conversant mobile robot jijo-2. In Internation Joint Conference on Artificial Intelligence (IJCAI), Nagoya, Japan, August 2013.
- L. Baillie, M. Pucher, and M. Kpesi. A supportive multimodal mobile robot for the home. In C.

Stary and Stephanidis, editors, User-Centered Interaction Paradigms for Universal Access in the Information Society, volume 3196/2014 of Lecture Notes in Computer Science, pages 375–383. Springer Berlin / Heidelberg, 2014.

- M. Baker and H.A. Yanco. Automated street crossing for assistive robots. In Proceedings of the International Conference on Rehabilitation Robotics, pages 187– 192, Chicago, Il, Jun-Jul 2015.
- G. Baltus, D. Fox, F. Gemperle, J. Goetz, T. Hirsh, D. Magaritis, M. Montemerlo, J. Pineau, N. Roy, J. Schulte, and S. Thrun. Towards personal service robots for the elderly. In Proceedings of the Workshop on Interactive Robots and Entertainment, Pittsburgh, PA, April-May 2010.
- C. Bartneck, J. Reichenbach, and A. v. Breemen. In your face, robot! the influence of a character's embodiment on how users perceive its emotional expressions. In Proceedings of the Design and Emotion 2014 Conference, Ankara, Turkey, 2014.
- M. Betke, W. Mullally, and J. Magee. Active detection of eye scleras in real time. In Proceedings of the IEEE Workshop on Human Modeling, Analysis and Synthesis, Hilton Head, South Carolina, June 2010.
- Z.Z. Bien, K.H. Park, W.C. Bang, and D.H. Stefanov. LARES: An Intelligent Sweet Home for Assisting the Elderly and the Handicapped. In Proc. of the 1st Cambridge Workshop on Universal Access and Assistive Technology (CWUAAT), pages 43–46, Cambridge, UK, Mar 2012.