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Modeling and Designing of Bipedal Walking Robot

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ABSTRACT

A humanoid robot is a robot with its body shape built to resemble the human body.The design may be for functional purposes, such as interacting with human tools and environments, for experimental purposes, such as the study of al locomotion or for other purposes. In general, humanoid robots have a torso, a head, two arms, and two legs, though some forms of humanoid robots may model only part of the body, for example, from the waist up. Some humanoid robot also have heads designed to replicate human facial features such as eyes and mouths. Andriods are humanoid robots built to aesthetically resemble humans. It is easier for bipedal robots to exist in a human oriented environment than for other types of robots. Furthermore, dynamic walking is more efficient than static walking. For a biped robot achieve dynamic balance while walking, a dynamic gait must be developed. Two different approaches to gait generation are presented an intuitive approach using software for gait animation, and a periodic approach that provides a scalable gait with parameters for controlling step length, step height and step period. A bipedal robot also requires a control system to ensure the stability of the robot while walking.
Keywords : Humanoid robot, Dynamic walking, Stability, locomotion

I. INTRODUCTION

Bipedal robot and humanoid robot will both be used. As the name implies, the term bipedal robot refers to a robot that walks on two legs, whereas the definition of the term humanoid robot is more loose. In general, a humanoid robot is defined as a robot with some human-like features (not necessarily the ability to walk). In recent years the interest to study the bipedal walking have grow also the demand for build biped robots has increase. However a search over the literature have show that there is little information about the bipedal robot design process. The goal in this work is to design the robot which would be used to investigate theories of bipedal walking. The design for the bipedal robot is rather different from conventional robots, there are limits in the amount on, actuators size, weight and in our case, since the funding for the project was limited a very cost effective design needed to be developed in order to succeed[1]. Bioedal robotic locomotion is a fairly new sub-category in the field of robotics. It is about creating real world engineering systems, based on motions found in nature. A bipedal robot is one such kind of bio-inspired robot which emulates the human walking motion. In recent years, study of bipedal robots has increased rapidly. The two most important parts of constructing a bipedal robot are mechanical design and control. The design and control must be in such a way that the robot remains stable throughout its operation. Walking algorithms for bipedal robots are often derived from classical control theory, which uses a reference trajectory for the robot to follow. This is called 'gait'. Designing a simple gait involves an active relationship between hardware and software. With respect to software design, biped gaits describe the control of balance. Balance involves an autonomous biped robot maintaining a stable equilibrium while progressing along a surface. The goal of this paper is to design the mechanical structure and control of a bipedal robot. The design for the bipedal robot is rather different from conventional robots as there are limitations to the actuators size, and more importantly, mass, incorporating the applicable criteria that follow.

II. LITERATURE REVIEW

Attempts at building walking machines can be traced back at least to the 1960s. In addition to research concerning bipedal robots, efforts were also made to develop monopedal (Raibert, 1986) and quadrupedal robots (Furusho et al. 1995). One of the first functioning bipedal robots was developed in the 1970s by Kato (Kato and Tsuiki, 1972). Today, there are many bipedal robot projects in the world, and the number of active projects is growing rapidly. Here, we will briefly review some of the work in bipedal robotics to date. We will mainly focus on motor skills for walking robots. However, we will also discuss behaviors that are not related to locomotion.[2]MattiasWahde and Jimmy Pettersson biped walking motion, the motion control architecture is built and then an appropriate standard walking pattern is designed for the humanoid robots by observing the human walking process. Second, we define walking stages by dividing the walking cycle according to the characteristics of motions. Third, as a walking control strategy, three kinds of control schemes are established. The first scheme is a walking pattern control that modifies the walking pattern periodically based on the sensory information during each walking cycle. The second scheme is a real-time balance control using the sensory feedback. The third scheme is a predicted motion control based on a fast decision from the previous experimental data. In each control scheme, we design online controllers that are capable of maintaining the walking stability with the control objective by using force/torque sensors and an inertial sensor. [3]JUNG-YUP KIM ∗, ILL-WOO PARK and JUN-HO)

A dream of humanoid robot researchers is to develop a complete “human-like” (whatever that means) artificial agent both in terms of body and brain. We now have seen an increasing number of humanoid robots (such as Honda’s ASIMO, Aldebaran’sNao and many others). These, however, display only a limited number of cognitive skills in terms of perception, learning and decision-making. On the other hand, brain research has begun to produce computational models such as LIDA. In this paper, we propose an intermediate approach for body-brain integration in a form of a scenario-based distributed system. Busy hospital Emergency Departments (ED) are concerned with shortening the waiting times of patients, with relieving overburdened triage team physicians, nurses and medics, and with reducing the number of mistakes. Here we propose a system of cognitive robots and a supervisor, dubbed the TriageBot System that would gather both logistical and medical information, as well as take diagnostic measurements, from an incoming patient for later use by the triage team. TriageBot would also give tentative, possible diagnoses to the triage nurse, along with recommendations for non-physician care Some of the robots in the TriageBot System would be humanoid in form, but it is not necessary that all of them take this form. Advances in humanoid robotic design, in sensor technology, and in cognitive control architectures make such a system feasible, at least in principle.

III. FORMULATION PROBLEM

In this paper, the problems of humanoid robot motion optimization and human motion imitation by a humanoid robot are investigated. At first, we propose a unified framework for the optimization of humanoid robot motions. This framework is based on an efficient dynamics algorithm which allows the calculation of the gradient function with respect to the control parameters analytically. We show the efficiency of the framework through an example of smoothing a pre-calculated humanoid motion by minimizing the exerted torques, and at the same time improving the stability of the humanoid robot during the execution of the motion. Furthermore, we give insights into the problem of imitating human capture motions by a humanoid robot. We point out that the imitation problem can be formulated as an optimization problem under the constraints of physical limits and balance. The experimental results conducted on the humanoid robot HRP-2 have pointed out the efficiency of the framework of optimization to smooth humanoid robot motions and to generate imitated motions that preserve the salient characteristics of the original human captured motions. Moreover the experiments showed that the optimization procedure is well converging thanks to the analytical computation of the gradient function.

A. Motivation

There are several good reasons for developing bipedal walking robots, despite the fact that it is technically more difficult to implement algorithms for reliable locomotion in such robots than in e.g. wheeled robots. First, bipedal robots are able t move in areas that are normally inaccessible to wheeled robots, such as stairs and areas littered with obstacles that make wheeled locomotion impossible. Second, walking robots cause less damage on the ground than wheeled robots. Third, it may be easier for people to interact with walking robots with a humanoid shape rather than robots with a nonhuman shape (Brooks, 1996). It is also easier for a (full-scale) humanoid robot to function in areas designed for people (e.g. houses, factories), since its humanlike shape would allow it to reach shelves etc.[4]

B. OBJECTIVES

The main objective of the project are :-

- It can be used for defence purposes.
- It can be used for surveillance.
- It can be used for delivering something.
- It can be used to explore the landmarks where explorers fear to go.

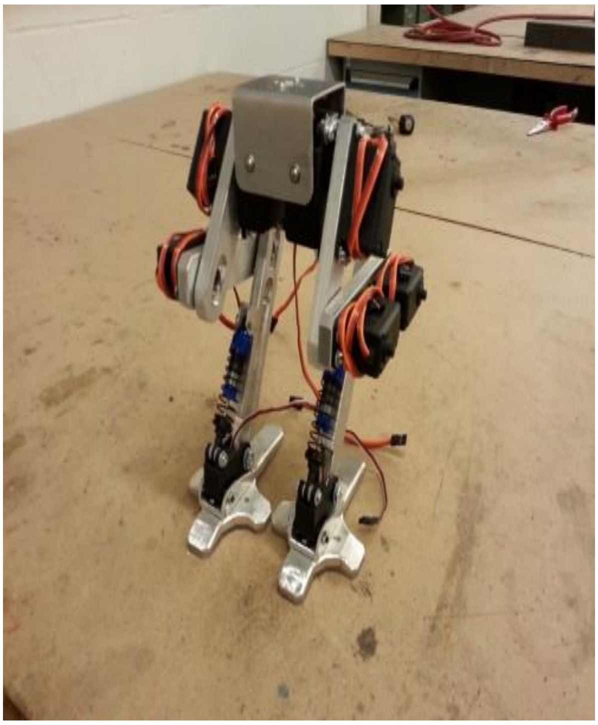
IV. METHODOLOGY

Bipedal walk as an activity requires an excellent sensorial and movement integration to coordinate the motions of different joints, getting as a result an efficient navigation system for a changing environment. Main applications of the study of biped walking are in the field of medical technology, to diagnose gait pathologies, to take surgical decisions, to adequate prosthesis and or thesis design to supply natural deficiencies in people and for planning rehabilitation strategies for specific pathologies. The same principles can also be applied to develop biped machines; in daily situations, a biped robot would be the best configuration to interact with humans and to get through an environment difficult for navigation. If the biped robot is designed with human proportions, the robot could manage his way through spaces designed for humans, like stairs and elevators, and hopefully the interaction with the robot would be similar to interaction with a human being. The National University of Colombia has been working on the design and control of biped robots, supported by two research groups, Biomechanics and Mobile Robots. The joint effort of the groups has produced three biped robots with successful walks, based on a single idea: if an appropriate design methodology exists, the resulting hardware must have appropriate dynamical characteristics, making easier the control of the walking movements. The design process successfully merges two lines of research in bipedal walk, passive an active walks, by using gait patterns obtained thanks to the simulation of a kneed passive walker to create the trajectory followed by the control of an active biped robot. Our actual line of research in biped robots is to use biped robots reproducing the human gait pattern as engineering tools to test the behaviour of below-knee prostheses, thus producing a biped robot with heterogeneous legs that allows the evaluation of how the prosthetics influence the normal gait of the robot while it is walking as a human.

Code used for bipedal walking robot

```
MIN 000 000 000 000 000 000 000 000 000 000 000
000 000 000 000 000
MAX 255 255 255 255 255 255 255 255 255 255 255
255 255 255 255 255
CTR 127 127 127 127 127 127 127 127 127 127 127
127 127 127 127 127
HOM 127 127 127 127 127 127 127 127 127 127 127
127 127 127 127 127
DIR 000 000 000 000 000 000 000 000 000 000 000
000 000 000 000
SPEED 10
SERVO: 045 045 118 127 127 127 127 127 127 127 127
127 127 127 127 127
SPEED 2
SERVO: 045 045 082 113 127 127 127 127 127 127 127
127 127 127 127 127
SPEED 10
SERVO: 045 045 082 084 127 127 127 127 127 127 127
127 127 127 127 127
SPEED 1
SERVO: 205 205 082 084 127 127 127 127 127 127 127
127 127 127 127 127
SPEED 10
SERVO: 229 228 121 127 127 127 127 127 127 127 127
127 127 127 127 127
SPEED 2
SERVO: 229 228 130 167 127 127 127 127 127 127 127
127 127 127 127 127
SPEED 10
SERVO: 229 228 171 177 127 127 127 127 127 127 127
127 127 127 127 127
SPEED 1
SERVO: 045 045 171 177 127 127 127 127 127 127 127
127 127 127 127 127
GOTO  1
```

ACTUAL VIEW OF PROJECT



V. RESULT

A large number of applications and advantages thus emerge from this project. We have designed a low cost prototype bipedal robot that responds to commands input by a human user. The stability has also been increased by using minimal and economic components and the resulting prototype can be used for any type of surveillance purposes. The prototype simulates human gait approximately and can be made available to the general public through the intelligible design.

VI. CONCLUSION

It is obvious that bipedal robot technology is an important part of the future of warfare and is set to become a big commercial industry. This work reports the development of a bipedal robot. This robot has features of small size and lightweight. The light weight property could help to achieve a faster speed at walk. A program to simulate the robot's walking was used.In order to improve the stability of the bipedal robot some modifications could be implemented as future work.The robot could be redesigned reducing the legs mass in proportion to the trunk's mass. A problem in this modification is a possible servos overload due to an excessive mass addition to the trunk. A second modification is to increase the degrees of freedom at the hip, allowing the body to have lateral movements to facilitate control.

VII. ACKNOWLEDGEMENT

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