DANCING ROBOT FOR ROBOT CONTEST

MOHD NAJID BIN MAHMOOD @ MAHMUD

MARCH 2005

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ACQUISITION

"Saya mengakui laporan ini adalah hasil kerja saya sendiri kecuali ringkasan dan petikan yang tiap-tiap satunya saya jelaskan sumbernya."

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Tarikh : 9/MAC/2005

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ABSTRACT

In this modern technology world, robot is one of the biggest future plan. Some people believe that robot can do work like a human. Even the robot can move such as human. That is the main objective of this project is to build one robot where it can dancing. It was not an easy experiment because to make a robot move we have to spend lot of time and lot of money. The design of the robot will be determined by its intended applications. The second objective of this project is to design the dancing robot for robot contest by using PLC (Programmable Logic Controller). This robot can dance and move as softly as it can. The resulting design is the robot movement will be control by only one button. The Programmable logic controller (PLC) is used to control the motor, and the mechanical design will make the movement. Every movement follows the command that come from the programme that was install in the PLC.

ABSTRAK

Di dalam dunia moden yang penuh dengan teknologi, bidang robotics adalah sesuatu yang luas. Sesetengah manusia percaya robot boleh bergerak seperti manusia biasa. Objektif utama di dalam projek ini adalah untuk mereka sebuah robot yg boleh menari. Ini bukanlah sesuatu keje yang mudah kerana memerlukan banyak masa, dan juga modal yang besar. Rekaan robot tersebut adalah menerangkan applikasinya. Objektif kedua adalah untuk mereka robot yang menari untuk pertandingan dengan menggunakan Program kawalan logic (PLC) yang akan mengawal pergerakan robot tersebut. Pergerakan robot ini boleh bergerak secara halus yang boleh. Robot ini akan dikawal dengan menggunakan satu suis. PLC akan digunakan untuk mengawal motor, dan sementara reka bentuk dalaman pula akan menghasilkan pergerakan. Pergerakan motot adalah mengikut arahan aturcara yang dibuat yang telah di programkan ke dalam PLC.

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CHAPTER 1

DANCING ROBOT FOR ROBOT CONTEST

1.1 Introduction

In this modern technology world, robot is one of the biggest future plans. Some people believe that robot can do work like a human. Even the robot can move such as human. The main objective of this project is to build one robot that can move both of hand and legs. It was not an easy experiment because to make a robot move we have to spend lot of time and lot of money. The design of the robot will be determined by its intended applications

Robot is the one type of complicated machines in the world. This is not an easy work for one people who want to make or built a robot. It needed too much research, references, experiment, practical, mechanical training, computer programming, theory and ideas. All robotic have been programmed by microprocessor programming.

This project is focusing on developing of dancing robot technology. From the title it can be divided into five major parts. Firstly in term of software programming of PLC (FP0), secondly is stability of force, body part designed, movement and electronic circuit design.

The robot is fully controlled by Programmable Logic Controller (PLC).This project using the PLC type FP0 which have been publish by NAIS (Matshushita Electric Works Sdn Bhd). This PLC must be installing with the program that have create by FPsoft. Then PLC has connected and control the relays and then to the dc motor by electronics circuit system.

he movement of robot is depends on movement of dc motor. So that is the complicated work to how create design for make connection between dc motor with hand and leg. Idea for create mechanical design of body robot is needed. So this dancing robot can move their hand and legs in same time which control by PLC.

.After the robot has been completed, this robot will enter the robot contest which hosting by SIRIM Bhd.

CHAPTER 2

PROJECT OBEJCTIVE

The main objective in this project is to design one robot which can move both of hand and head. To make the movement, the first step is to design a frame of hand. This frame is connected to the dc motor to yield the movement. The same step is using for make the movement of the head.

Second objective of this project is to take part into dancing robot contest where hosted by SIRIM BHD. This contest aims at testing the ability of contestants to design dancing robot. Every robot is required to dance along to their chosen song in three minutes. The robot that dances according to the tune and is attractively dressed will be declared the winner.

2.1 Project Objective

1. To design and implement the Dancing Robot.
2. Using Programmable Logic controller (PLC) as a controller.
3. To take part for robot contest.

CHAPTER 3

LITERATURE REVIEW

3.1 Literature review

Embodied AI in Humanoids

Henrik Hautop Lund Luigi Pagliarini Leonid Paramonov Morten Winkler Jørgensen
Maersk Mc-Kinney Moller Institute for Production Technology
University of Southern Denmark, Campusvej 55, 5230 Odense M., Denmark

The mechanical structure of the robot is based on several simple parallel or non-parallel prismatic structures which allow us to simplify the performed by hips structure that uses one parallel prismatic structure actuated by one motor in the middle. So, depending on which leg is on the ground, the left step forward or the right step back (for instance) will be performed by the same hips action. Two motors for rotation of the legs motor are installed in left and right hips units so that it is possible to rotate one leg for more than a half of a revolution. As a result not only the straight step could be done but also steps combined with rotation around the foot place, which turn the robot around the standing leg and also allow the "swing" leg to prepare for the next action. Finally, one single motor is used to shift both arms to the same side.

A Second Generation Small Walking Robot

Modular Robot Leg Design

Prepared For: Professor J. McPhee, Workshop Supervisor

Prepared By: Paul Laderoute, John Macintyre and Rhae-Christe Shaw

Department of Systems Design Engineering, University of Waterloo

April 17, 1998

A set of criteria and constraints were developed for the mechanical redesign of the robot leg. The criteria for the redesign were aimed at eliminating the identified limitations of the previous design. They required that the new leg provide greater strength, adequate robot speed, a symmetrical design, the incorporation of limit switches, improved foot traction, three degrees of freedom and a modular design.

The minimum strength requirement imposed on each leg was determined by considering the maximum portion of the overall robot weight that a leg would need to support. Two of the three legs on one side of the robot could be lifted simultaneously. In this case, a leg would be required to support half of the weight of the robot body as well as the weight of the two lifted legs. The current weight of Hexplorer, including its legs is approximately 10 kg. The new leg was designed to support half of the weight of a 16 kg robot (i.e. 8 kg).

Each actuated joint was required to rotate at a minimum velocity of one radian per second at peak torque. This translates into walking and rising speeds of about 17cm/s, which was deemed adequate.

A symmetrical design (equivalent ranges of motion forwards and backwards) was necessary to eliminate robot orientation and increase maneuverability.

To protect both the body and the leg components, the design was required to incorporate limit switches and/or mechanical stops to restrict the range of motion of the leg.

Alterations to the foot were also desired to improve traction and stabilize the robot on non-ideal surfaces (i.e. sand, steps, and inclines). A three rotational degree of freedom joint (spherical joint) situated above the foot was also desired to help eliminate unwanted motion between the foot and the ground.

In order to be compatible with the existing control algorithm, the new design was required to have three degrees of freedom (i.e. three sensors and three actuators were required on the leg).

For ease of replacement, repair and calibration, a modular leg design was required. A self contained leg allows for the leg to be mounted on other compatible robot bodies, or for other legs (of similar design) to be mounted on Hexplorer. That is, the new leg required simple mechanical, power and feedback interfaces with the body. The mechanical interface design was required to firmly fix the leg to the body component, but allow for the leg to be easily attached/removed. The feedback interface was required to support all sensors and the power interface was required to support all actuators.

The new leg design was constrained by time, cost and the availability of some leg components (i.e. actuators and gears). The material selection was further constrained by weight and ease of machining.

3.2 Comment of review

To make dancing robot must have creativity and more idea. Design and structure of robot will shown the movement of robot. The movement of the robot is controlled by rotation of motor. All robots used the microprocessors to control the motor, but is this project use Programmable logic controller (PLC) as a controller. The skills of electric, electronics and mechanical must have to create the robot.

CHAPTER 4

DATA COLLECTED

4.1 Dancing Robot

Definition of robot is mechanical device that sometimes resembles a human being and is capable of performing a variety of often complex human tasks on command or by being programmed in advance or one machine or device that operates automatically or by remote control. Dancing can be defined as taking a series of rhythmical steps (and movements) in time to music or moving quickly and excitedly; "on dancing feet". So the dancing robot can be defined as the movement of mechanical devices followed the music by being programmed in advance.

Walking robots have a potential to traverse certain types of terrain in a more efficient and stable manner than more conventional robots, using wheels or tracks. The property of walking robots that the contact with the ground is discontinuous gives them the ability to select footholds such that obstacles or holes are avoided. Other advantageous properties of walking robots are that they cause less damage to the terrain, active suspension is an intrinsic part of their structure, and they are omni directional, which gives them an advantage in maneuvering through cluttered and tight environments.

The dancing robot which control by motor, need to sketch the mechanical design and ideas to make combination between all part to get the movement. Use the motor for control the movement, means using the wheel or gear to generate the forces.

The control of walking robots requires that the issue of stability against tipping over is treated in a more specific fashion than for wheeled robots, as there are discrete changes in the support of the robot when the legs are lifted or placed. The stability of the robot is dependent on how the legs are positioned relative to the body and on the sequence and timing in which the legs are lifted and placed. In order to reduce the risk of the robot losing stability while walking, a measure for the stability of the robot is typically used in the gait and motion planning, in order to avoid, or detect, that the robot could become unstable.

4.2 Programmable logic controller (PLC)

A **programmable logic controller** or **PLC** is a small computer used for automation of real-world processes, such as control of machinery on factory assembly lines. Where older automated systems would use hundreds or thousands of relays and cam timers, a single PLC can be programmed as a replacement.

The PLC is a microprocessor based device with either modular or integral input/output circuitry that monitors the status of field connected "sensor" inputs and controls the attached output "actuators" (motor starters, solenoids, pilot lights/displays, speed drives, valves, etc.) according to a user-created, logic program stored in the microprocessor's battery-backed RAM memory. The functionality of the PLC has evolved over the years to include capabilities

beyond typical relay control; sophisticated motion control, process control, Distributed Control System and complex networking have now been added to the PLC's list of functions.

PLCs programs are generally written in a special application on a personal computer then downloaded over a custom cable to the PLC. The program is stored in the PLC either in battery-backed-up RAM or some other non-volatile memory.

Early PLCs were designed to be used by electricians who train on the job. These PLC's were programmed in "ladder logic", which strongly resembles a schematic of relay logic. Modern PLCs can be programmed in ladder logic or in more traditional programming languages such as C.

4.3 FP0-C14RS

This project purpose the NAIS (Matshushita Electric Works) product, FP0-C14RS types. FP0-C14RS is the main movement controller of dancing robot. All installation command in FP0 is built in PLC programming software (FP software). FP0-C14RS size is 90mm/3.543 inch high and 25mm/0.984 inch wide.

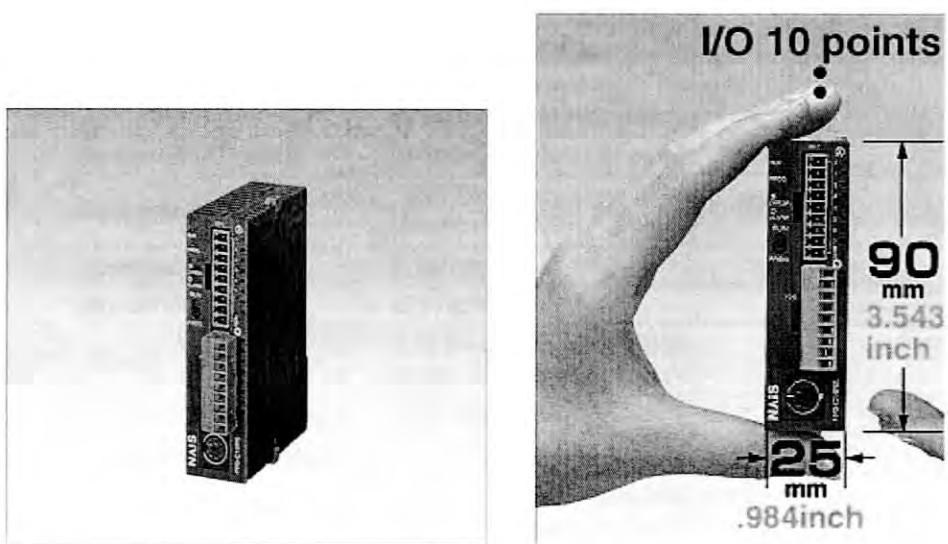

Figure 1: FP0-C14RS

4.3.1 Specification Data

The specification data list for FP0C14RS show the supply, performance, function, applicable network and other built in data. This PLC using common supply input and output relays.

Item			Description
Power supply and I/O Specifications	Power supply		24V DC
	Input		24V DC = common
	Output		Relay 2 A (resistor load) Transistor 0.1 A (varies with different models)
Performance Specifications	Number of I/O points		10 points/14 points/16 points/32 points
	Expansion		Max. 3 units Total points: Max. 128 points
	Operation speed		0.9μs/step
	Internal memory		EEP-ROM
	Memory capacity		2.7k steps/5k steps/10k steps (varies with different types)
	Operation memory	Internal relay	1008 points
		Timer/Counter	144 points in total
		Data register	1660 words/6144 words/16384 words (varies with different types)
Special functions	Pulse catch/Interrupt input		6 points in total
	Analog I/O		Available by adding analog unit
	Volume input		-
	High-speed counter		1 phase 4 points/ 2 phases 2 points (10 kHz in total)
	Pulse output note)		2 points (10 kHz in total)
	RS232C port		1 ch is equipped to 10k type the models having part numbers which end in C. 3F terminal blocks (made by Phoenix Contact Co.)
Applicable Network	Remote I/O		CC-Link, Slave station of MEWNET-F (use CC-Link unit I/O link unit)
	Computer link		Linkable with tool port or RS232C port (C type)
	Modem connection		Available, Type with RS232C port can also send data.
Other Built-in Functions	Program block-edit during RUN		Available
	Constant scan		Available
	Clock/Calendar function		-(built-in with 10k type)

Table 1: Specification Data