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Author(s)	Tatsuno, Kyoichi
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Open Robot Controller

Kyoichi Tatsuno

R & D Center, Toshiba Corporation, Saiwai-ku, Kawasaki 210-8582, Japan

SUMMARY:

Many robots are used in automobile assembling lines and electronics circuit assembling lines. But robot application field cannot spread to the other fields. It is important for robots to perform various kinds of jobs for robot business expansion. For trying to do various kinds of jobs, I think robot systems should be easily operated: they should be easy to assemble and use by one person. Open robot controllers are essential for that.

1. Present situation of robot business fields

Weld robots and painting robots in automobile assembling lines are widespread. Thus, the needs for these robots are limited to replace broken or old type robots.

New applications of robot technologies have been emerging in these 2 or 3 years. For examples, they are SONY's dog robot for amusements, human interface equipment for virtual reality (Haptics interface, Driving simulators), electronic chair vehicles, and moving beds for aged persons.

But these are only a few examples. Robots should try to do more and more jobs.

2. For trying to do jobs

The following are needed for trying to do jobs:

1) Analyzing jobs.

A working robot is defined by a job. A job is a sequence of tasks: picking, grasping, placing, inserting, polishing, fastening, pushing and so on. These tasks are described by motions of robot arm and status changes of working objects.

The motions of robot arm should be visualized by a CG simulator.

2) Making robot systems to be easily operated

A robot system is composed of arms, mobile mechanism and a vision system. Arms are for manipulating tools, mobile mechanism is for moving around a work object, and a vision system is for positioning the robot to the work object. For a mobile robot, visual position control is indispensable.

So far, we have spent much time to build up robot systems, but we have not made much effort to try to do jobs by using the robot systems. For trying to do jobs, it is essential that arms, mobile mechanisms and visions are modules, so that we can easily assemble a robot system with the modules. Also the software structure for robot systems should be open to users: the API for robot language, control programs of arms and mobile mechanisms, and signal processing programs of vision systems need to be available as much as possible or at least the interface should be open.

3) Improving torque/weight ratio of a joint actuator.

A robot has not enough power to manipulate heavy payloads because actuators that are composed of motors and harmonic reducers don't have enough torque/weight ratios. This limits robot applications.

3. Proposed open robot controller

We propose an open robot controller based on IBM-PC compatible board computers, which we can easily build up a system and write a program for robots as easily as we use personal computers. The proposed open robot controller is shown in Fig.1.

This controller is composed of the following four parts:

- 1) Human-machine interface, 2) Arm controller,
- 3) Mobile base controller,
- 4) Image processor.

These are connected through Ethernet or bus adapters. Motors and Sensors are connected through IEEE 1394 or simpler sequential communication protocol. I hope that all programs for robot control are open source, because many engineers and students can rewrite to improve the programs.

Robot systems, which can do jobs, will make good business.

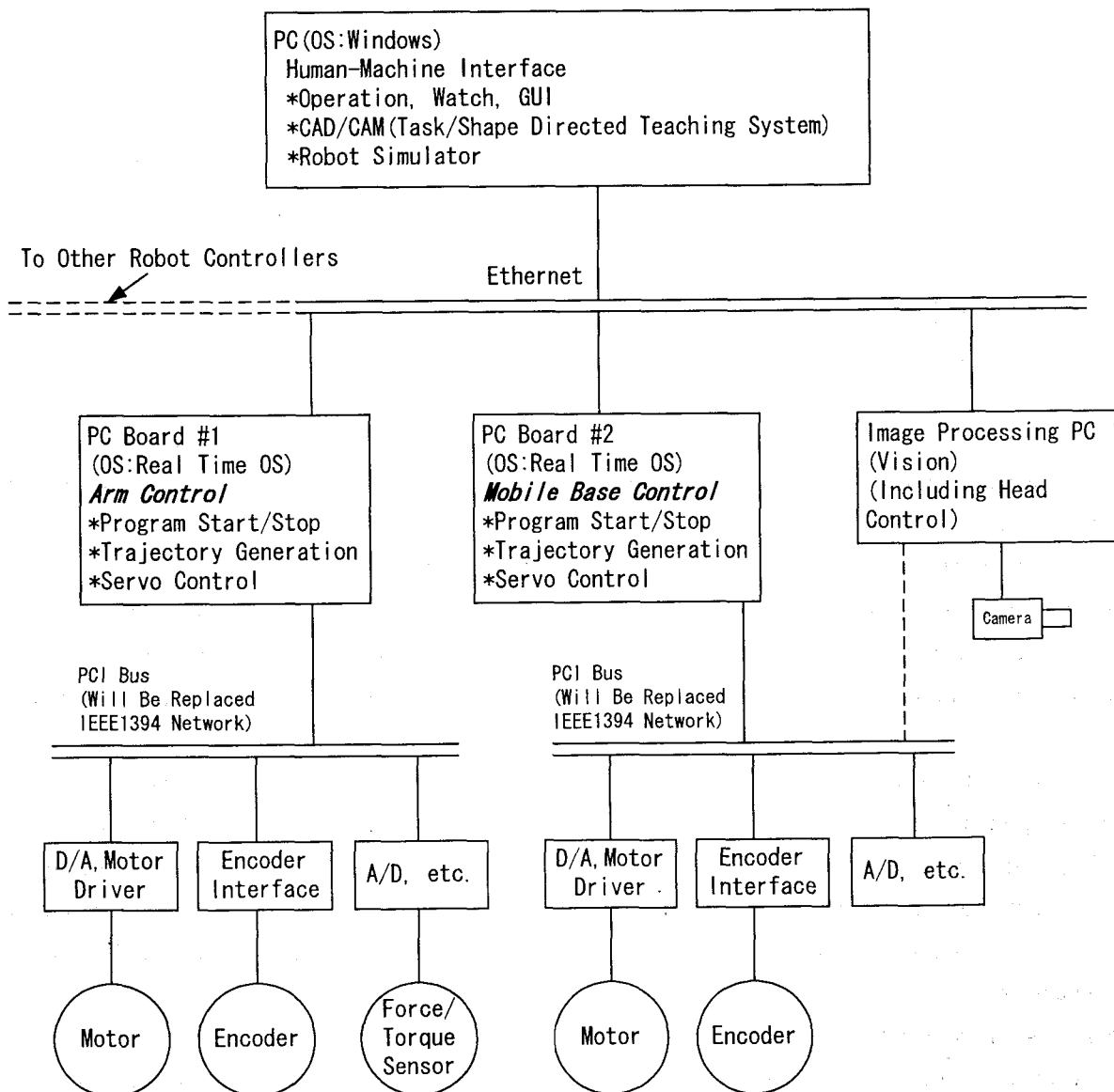


Figure 1 Proposed Open Robot Controller