

# Dr. Norbert Cheung's Lecture Series

Level 5      Topic no: 12

## Motion Applications Examples

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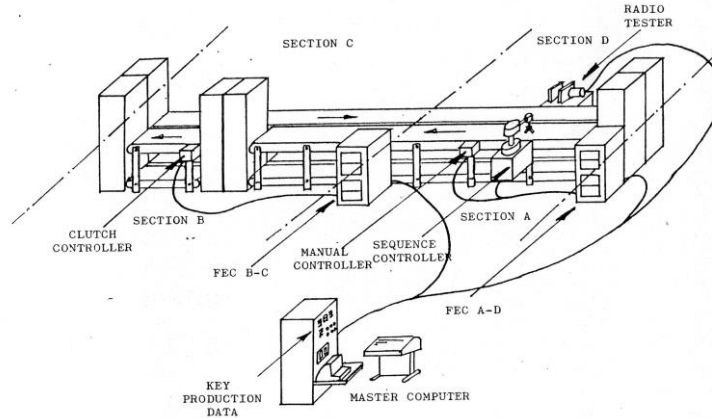
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## 1. Examples in Industry

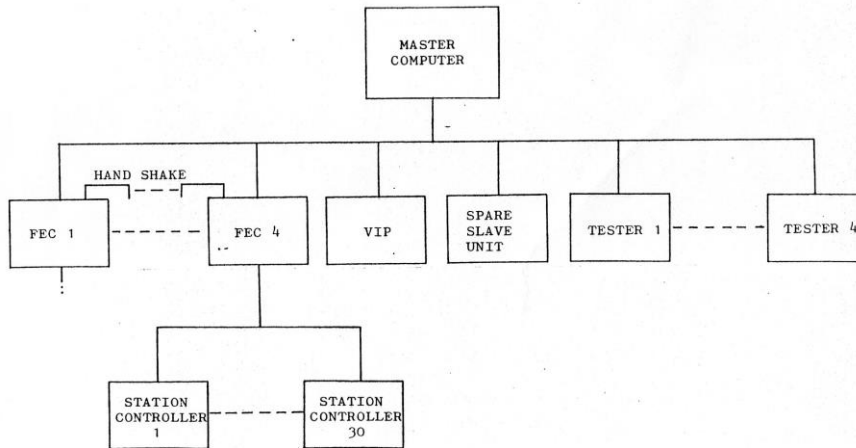
### Example 1

*Automate the Electronic Products Production Line*

*General Electric Company (HK) Limited, Kwun Tong.*



AUTOMATIC ASSEMBLY LINE - CONTROL SYSTEM



AUTOMATIC ASSEMBLY LINE - SIGNAL & CONTROL SYSTEM

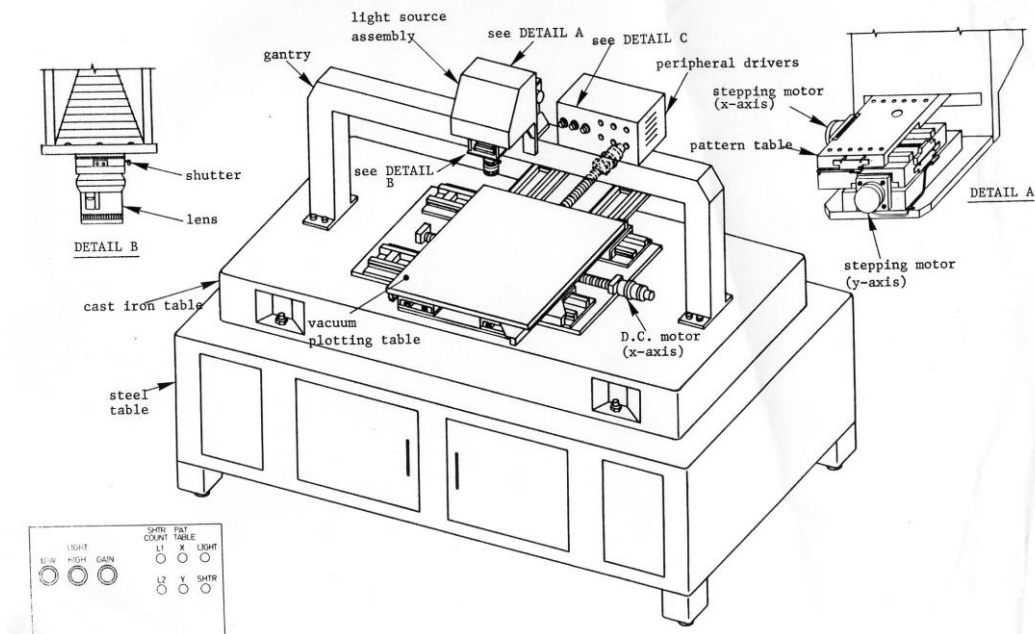
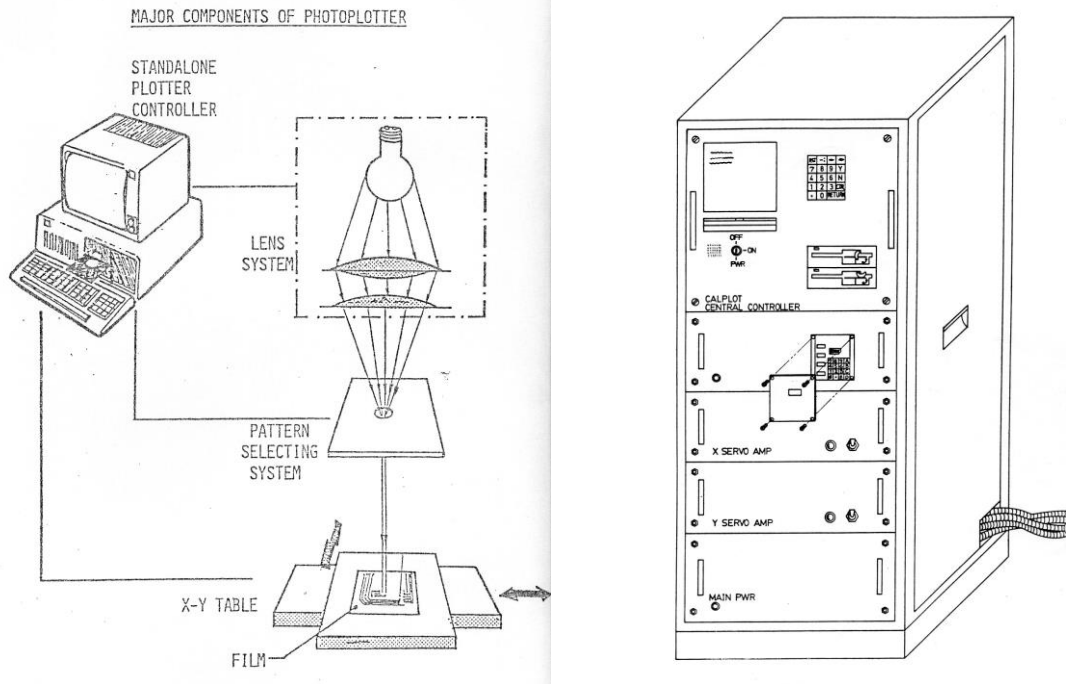
The Task is to replace human operators along the assembly with Pick and Place robots. The robots are synchronized by a master computer. Automatic loaders and unloaders, and automatic inspection machines are also developed.

**Example 2**

**Photo-plotter for PCB Production**

**Hong Kong Productivity Council**

**(now) Tat Chee Avenue, Kowloon Tong, Kowloon.**



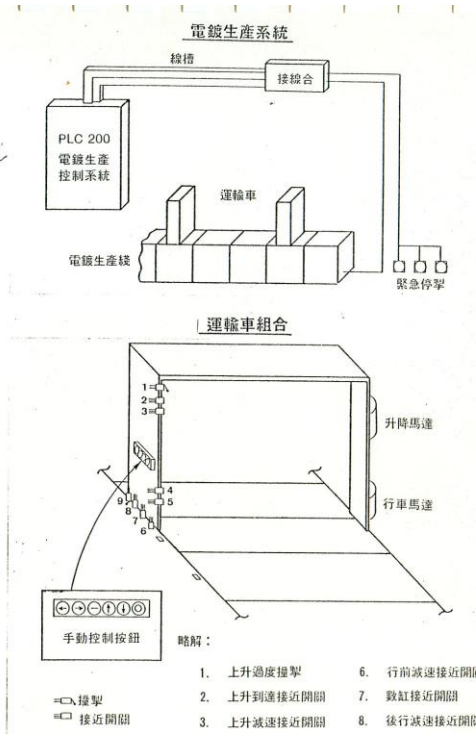
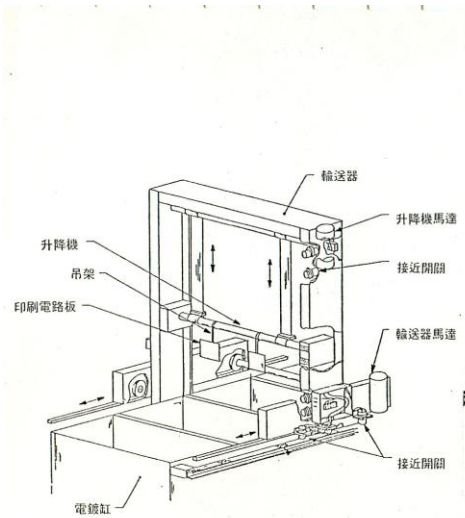
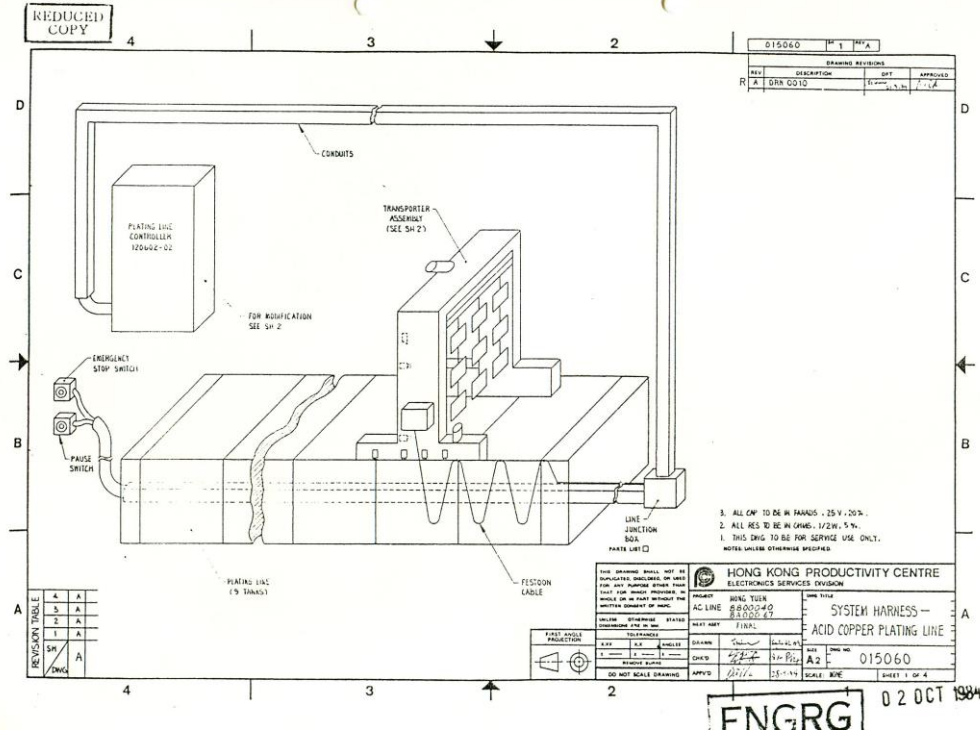
To produce a PCB production film by using light to draw onto a light sensitive plate.

**Example 3**

**Automatic Plating Line Controller**

Hong Kong Productivity Council

(now) Tat Chee Avenue, Kowloon, Kowloon.



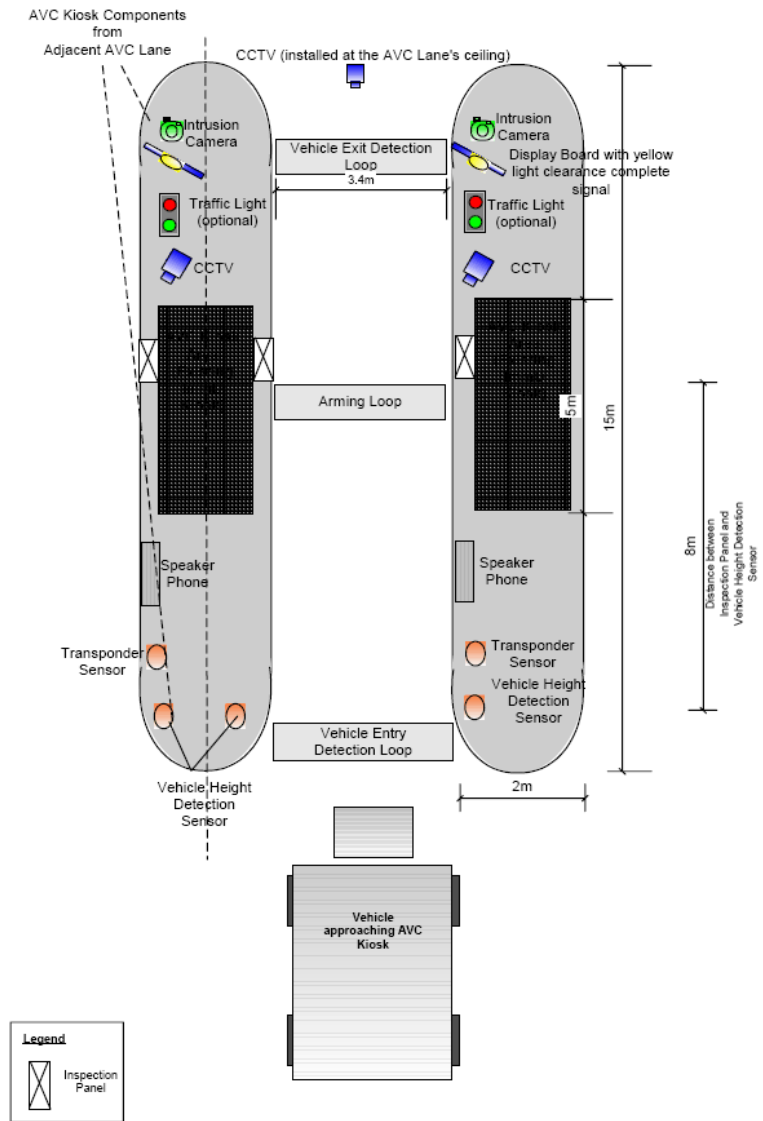
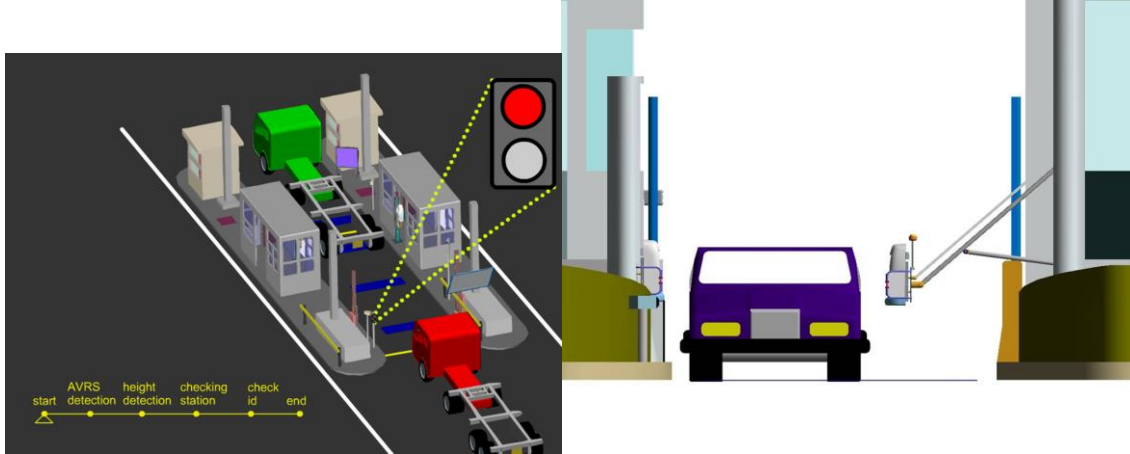
To use computer control to dip the products into chemical tanks in a pre-programmed sequential manner.

*Example 4*

*Automatic Vehicle Clearance System*

*ATAL, HK Polytechnic University*

*Client: HKSAR Government, Immigration Department*



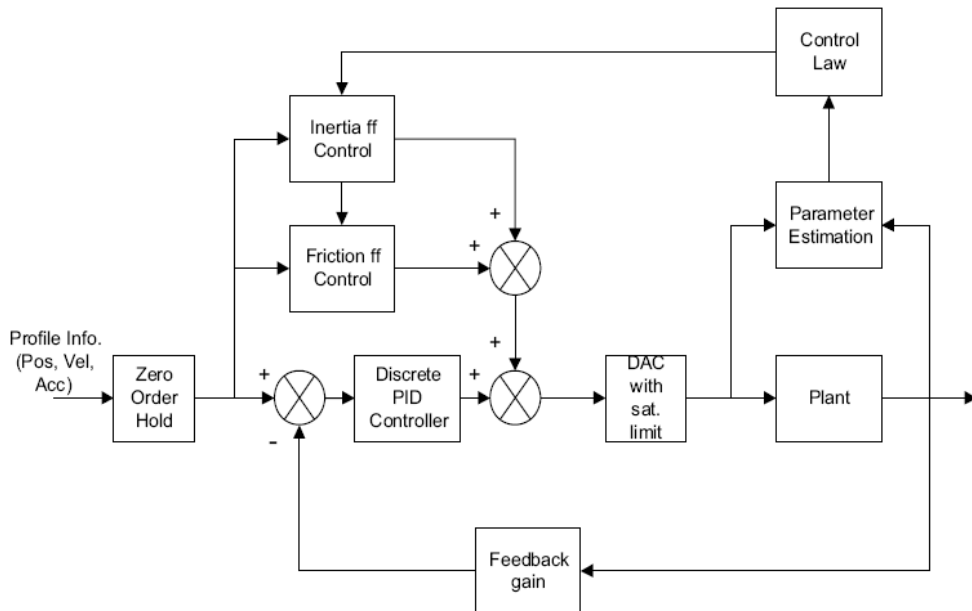
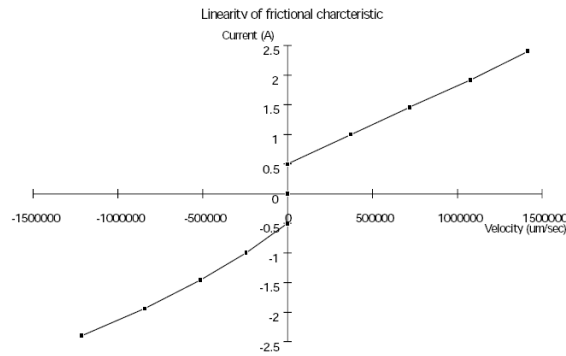
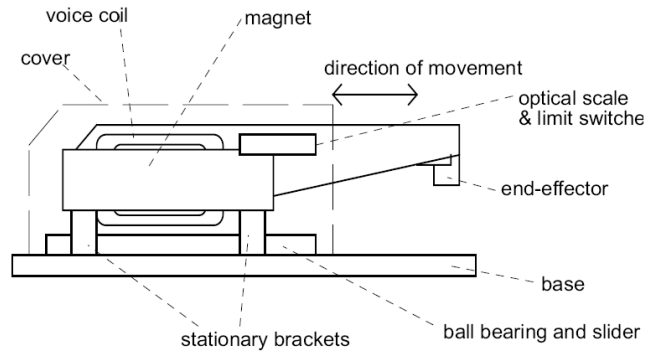
Note: The dimensions shown are based on the existing LMC ImmD Kiosk

## 2. Examples from Conference and Journal Papers

### Example 5

#### *Adaptive Friction and Inertia Compensation*

*(Download the full paper from the web)*

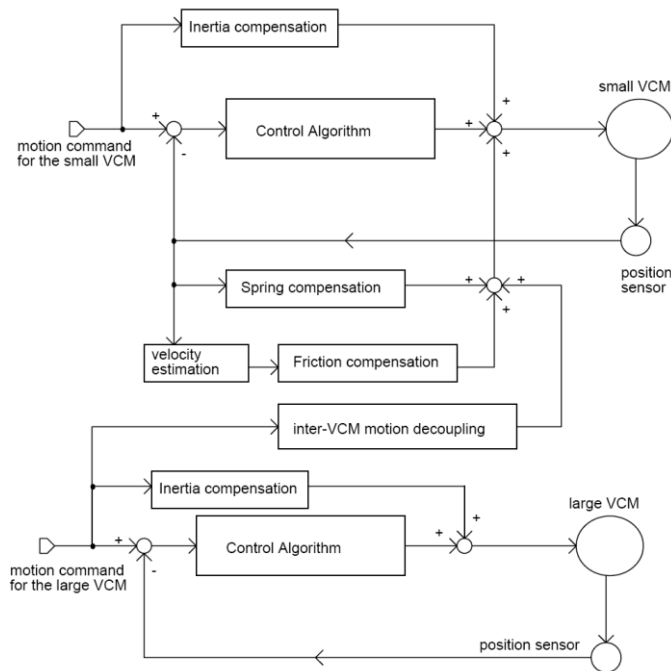
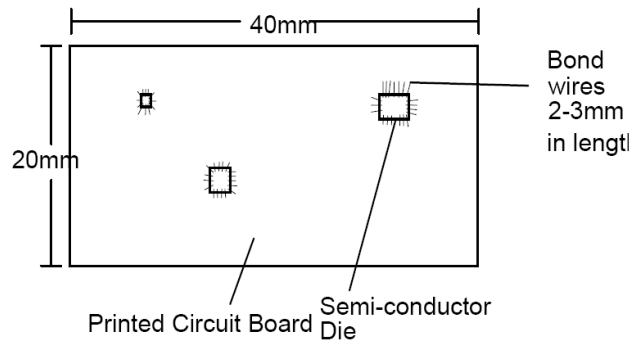
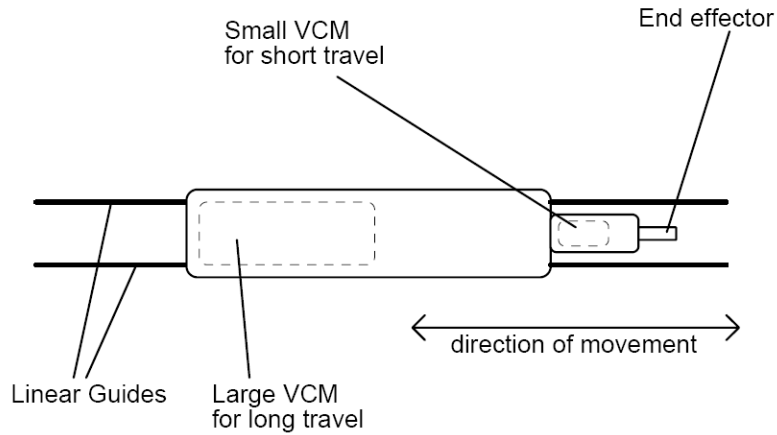


Top: Structure of the voice coil manipulator; Middle: The Friction Model of the Manipulator; Bottom: The Control Block Diagram.

**Example 6**

**High Speed Long Travel Dual Voice Coil Actuator**

*(Download the full paper from the web)*

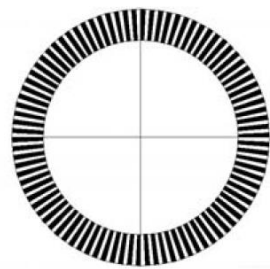
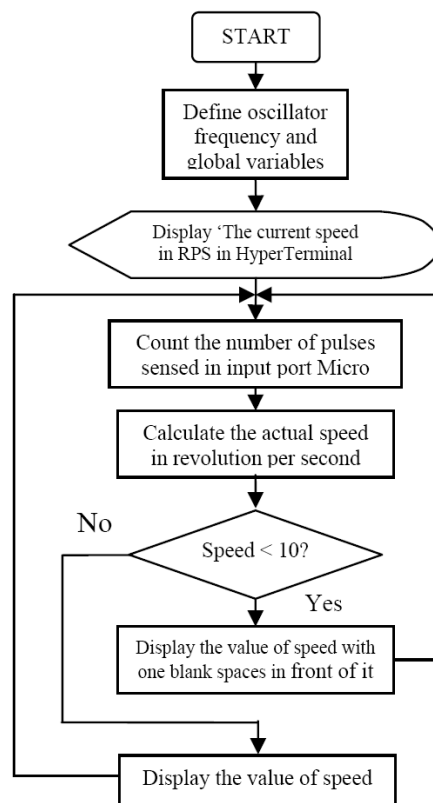
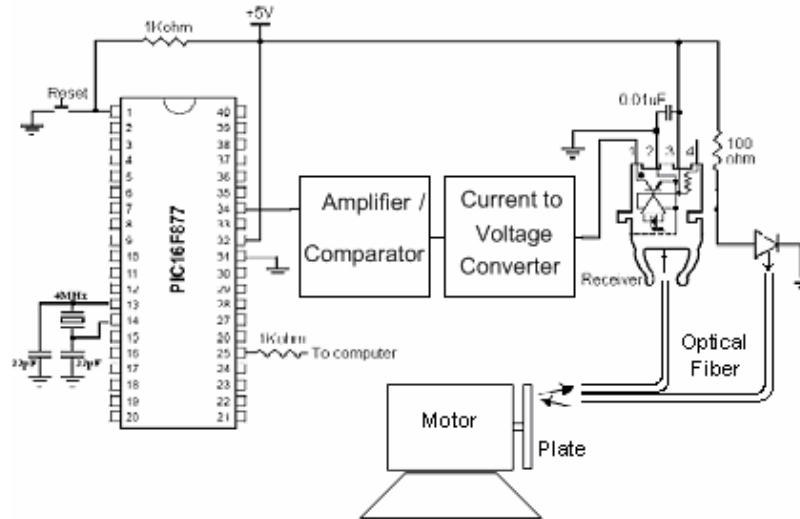


Top: Structure of the Dual Voice Coil Manipulator; Middle: The Target Working Environment; Bottom: The Control Structure

Example 7

*Fiber Based Speed Transducer*

*(Download the full paper from the web)*



Front view of the reflecting plate

A small project to measure the speed of a motor through optical means. Research project done in Malaysia.



### 3. Examples from Past Exam Papers

#### 2002/03 Past Paper

Figure Q5 shows the mechanical layout of a plating line system. A motion controller is used to drive the moving platform to pick and place the plating material from one tank to another, in a fixed sequence. The plating material should be handled very carefully; the motion platform should avoid sudden starting or stopping motions. Design the motion system for such equipment. Your design should include:

- (a) The hardware computing platform and its I/O interfaces. (7 marks)
- (b) The choice of input devices, motion sensors, and their interfaces. (3 marks)
- (c) The choice of output devices, actuators, and their drivers. (3 marks)
- (d) The overall software structure and the choice of operating system(s). (6 marks)
- (e) The overall layout, cabling, and inter-module signal transmission method of the plating line controller, in order to minimize the EMI/EMC problems. (6 marks)

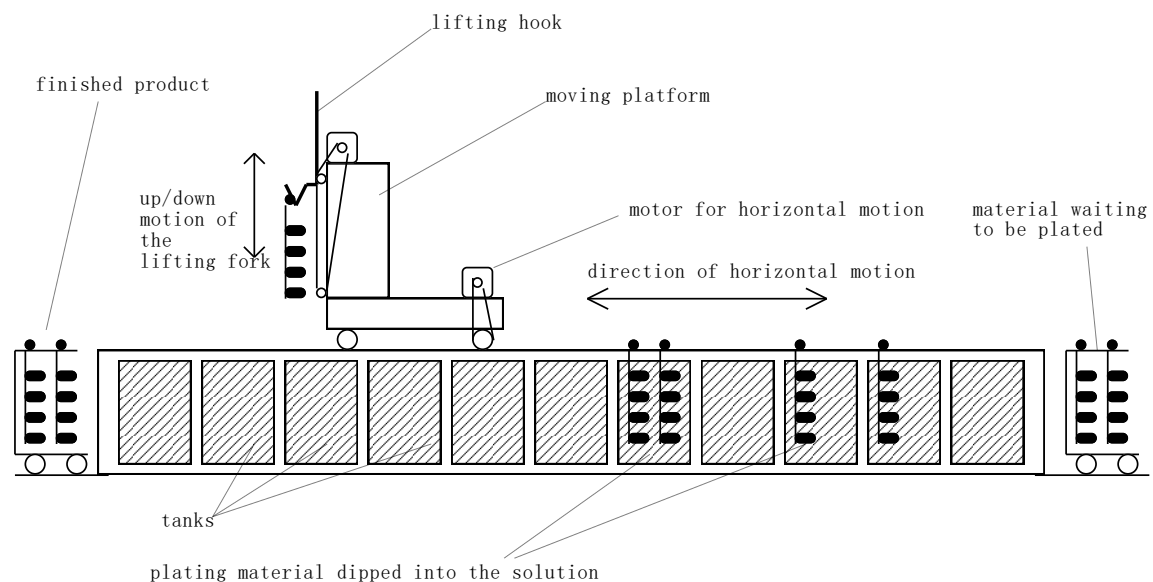


Figure Q5

**05/06 Past Paper**

The Hong Kong Government plans to implement automatic identity checks for all drivers crossing the Hong Kong China borders by 2008. To implement this goal, Automatic Vehicle Clearance Systems (e-way for drivers) are deployed along the borders between HK and China.

Fig. Q5 shows such a system. Once the vehicle enters the check in area, an intelligent sensor will scan the profile of the car, and two robot arms will automatically move the check-in kiosks to the vehicle's side windows (on the left hand side and on the right hand side). The passengers can do the Smart ID card finger print checking without leaving the vehicle.

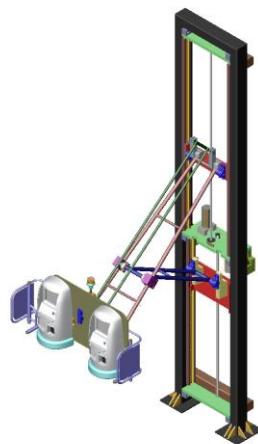


Fig. Q5

Design a motion controller for such an application.

5.12.a – Motion Applications Examples (last updated: May2022)

- (a) Suggest the choice of sensor to scan the profile of the car, and to determine the height of the driver's seat. (4 marks)
- (b) The choice of sensor to measure the horizontal distance between the robot arm and the car, for in/out motions. (4 marks)
- (c) Suggest the choice of motors and motor controls for the two robot arms. Describe how the motor controllers are linked to the computer. (4 marks)
- (d) Draw the overall hardware structure diagram of the system. (4 marks)
- (e) Use a structural chart or flow chart to design the overall software structure. (4 marks)

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