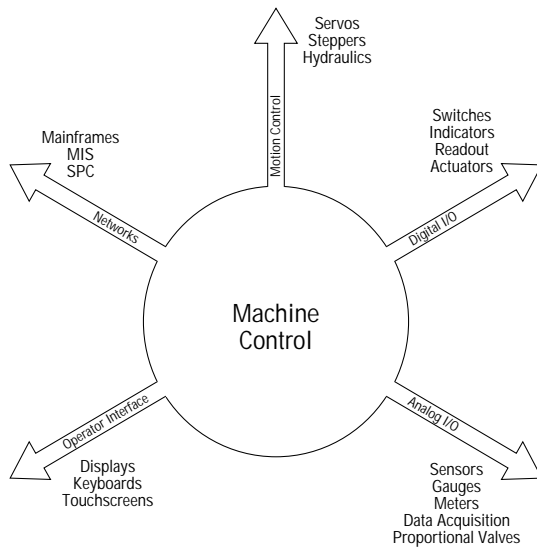


Machine Control

Many industrial designers are concerned with controlling an entire process. Motion control is one important and influential aspect of complete machine control. The primary elements of machine control include:

Fig. 5.1 Primary machine control elements



Motion Control: For precise programmable load movement using a servo motor, stepper motor, or hydraulic actuators. Feedback elements are often employed.

Analog and Digital I/O: For actuation of an external process, devices such as solenoids, cutters, heaters, valves, etc.

Operator Interface: For flexible interaction with the machine process for both setup and on-line variations. Touchscreens, data pads, and thumbwheels are examples.

Communications Support: For process monitoring, diagnostics and data transfer with peripheral systems.

There are many different machine control architectures that integrate these elements. Each results in varying levels of complexity and integration of both motion and non-motion elements. PLC-based, bus-based and integrated solutions are all commercially available. Your selection of a machine control strategy will often be based on performance, total application cost, and technology experience.

PLC-based Control

The PLC-based architecture is utilized for I/O intensive control applications. Based upon banks of relays that are scanned, or polled, by a central processor, the PLC provides a low-cost option for those familiar with its ladder logic programming language. Integration of the motion, I/O, operator interface, and communication are usually supported through additional cards that are plugged in its backplane.

The addition of scanning points decreases the polling rate of any individual point, and can thus lead to lower machine response. Because PLCs

have not historically concentrated on motion control, plug-in indexers or those that communicate over BCD are preferable. Because these indexer boards often include their own microprocessor, they prevent slow polling rates, but incorporate a separate programming language. In general, this compromise is acceptable for all but the most complicated motion/machine applications.

Bus-based Systems

Bus-based machine control systems are common in today's industrial environment. STD, VME and PC-AT are only a few of the numerous options. Most of these options can operate through a standard operating system (DOS, OS/2, OS/9) that can be used to program add-on cards for I/O, motion and communication interfaces. Flexible graphical operator interfaces remain one of the computer's major advantages.

Some successful examples of bus-based machine control applications include gear grinding and dressing, PCB placement machines, hard disk manufacturing, and automotive glass bending. Wherever intensive communications or data processing are required, the benefits of the bus structure can be realized.

There are some disadvantages to the bus-based machine control system that relate to the amount of integration between the motion and I/O structure. Separate cards are required for each, resulting in a need for software integration of different programming languages. Motion control operations, such as servo loops, should be polled and updated on a more immediate basis than auxiliary I/O or the operator interface. The programmer must develop this polling hierarchy to thread the system together.

Integrated controllers

A more integrated approach to machine control uses a stand-alone architecture that builds in the same essential elements of I/O, motion, operator interface, and communication. This approach uses a single software and hardware platform to control an entire machine application. The polling of servo loops, I/O points, and the operator interface are handled internally, invisible to the user. A common software language is provided to integrate the motion and I/O actuation. This pre-tested approach allows a typical machine control application to be developed with a minimum of effort and cost. The total application cost is the major consideration when selecting an integrated machine controller. While the initial hardware cost is typically higher than other solutions, the software investment and maintenance of a single language is an overriding and positive factor. Software development and maintenance costs for any machine control application can dwarf the initial hardware expense. The integrated approach offers a more economical solution.