Mechatronics

MKT 1821

Chapter-4

Evolution Case 1: The Development of Cars

Evolution Case 1: The Development of Cars

Until the 1960s, the radio was the only significant electronics in an automobile.

All other functions were entirely mechanical or electrical, such as the starter motor and the battery charging systems.

Modeling of the combustion process showed that, for increased fuel efficiency, there existed an optimal time when the fuel should be ignited.

- The timing depends on load, speed, and other measurable quantities.

Evolution Case 1: The Development of Cars

The electronic ignition system was one of the first mechatronic systems to be introduced in the automobile in the late 1970s.

The electronic ignition system consists of a crankshaft position sensor, camshaft position sensor, airflow rate, throttle position, rate of throttle position change sensors, and a dedicated microcontroller determining the timing of the spark plug firings.

The Antilock Brake System (ABS) was also introduced in the late 1970s in automobiles

The Traction Control System (TCS) was introduced in automobiles in the mid-1990s.

Evolution Case 1: The Development of Cars

Nowadays there are about 30-60 microcontrollers in each automobile. These processors are used for

- Engine management
- Transmission control
- Airbags
- ABS, TCS, VDC,
- Instrument cluster
- Air conditioning systems
- Seat, mirror control, and window lift systems.

Evolution Case 1: The Development of Cars

New applications of mechatronic systems in the automotive world include

Semi-autonomous to fully autonomous automobiles

Safety enhancements

Emission reduction

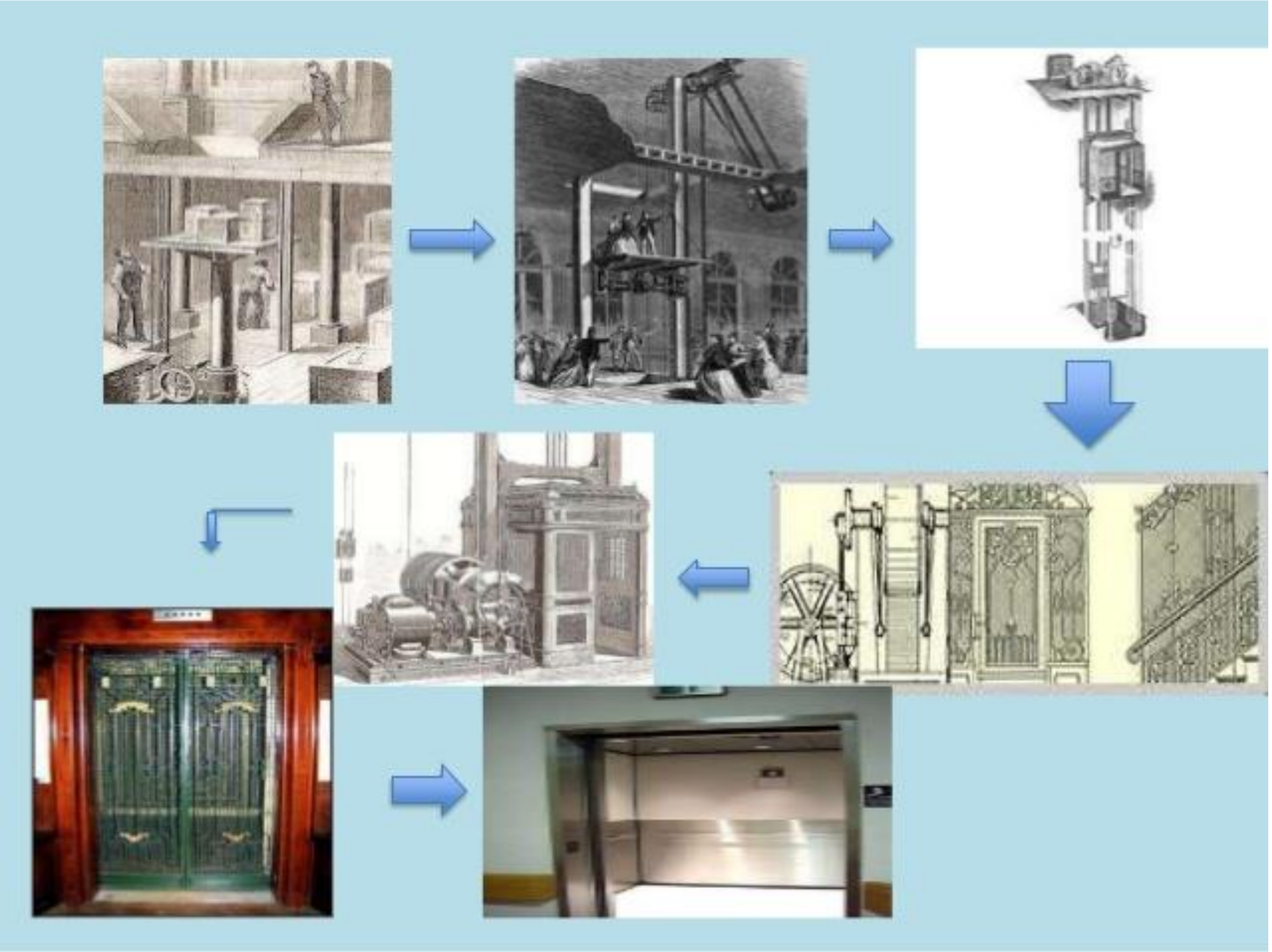
Intelligent cruise control

Brake by wire systems

Wireless networking of automobiles to ground stations and vehicle-to vehicle communication.

Telematics, which combines audio, hands-free cell phone, navigation, Internet connectivity, e-mail, and voice recognition

Evolution Case 2: The Development of Elevators



Evolution Case 2: The Development of Elevators

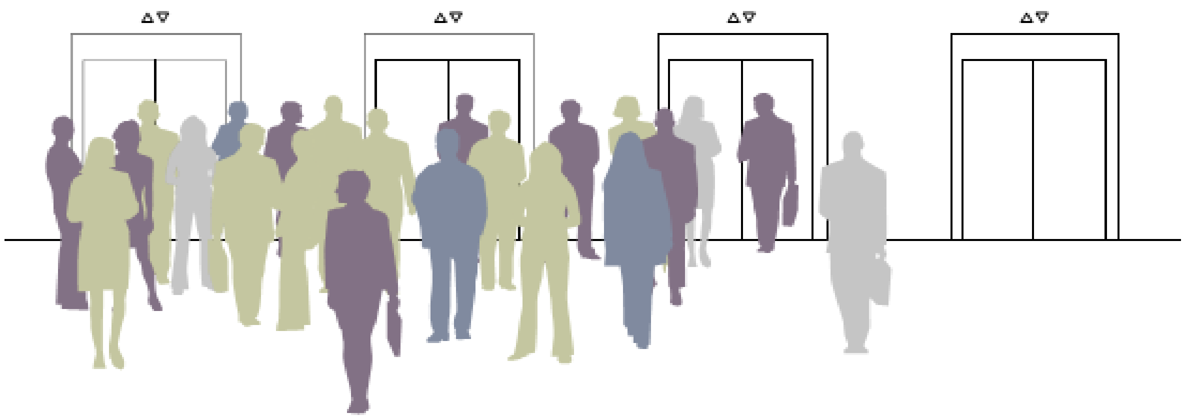
The world's first successful; and more importantly safe, passenger elevator was designed back in March 1857, by Elisha Otis.

It was installed in the five-story 24m tall Haughwout Building on Broadway in New York City. It cost $300 and moved at about 20cm per second.

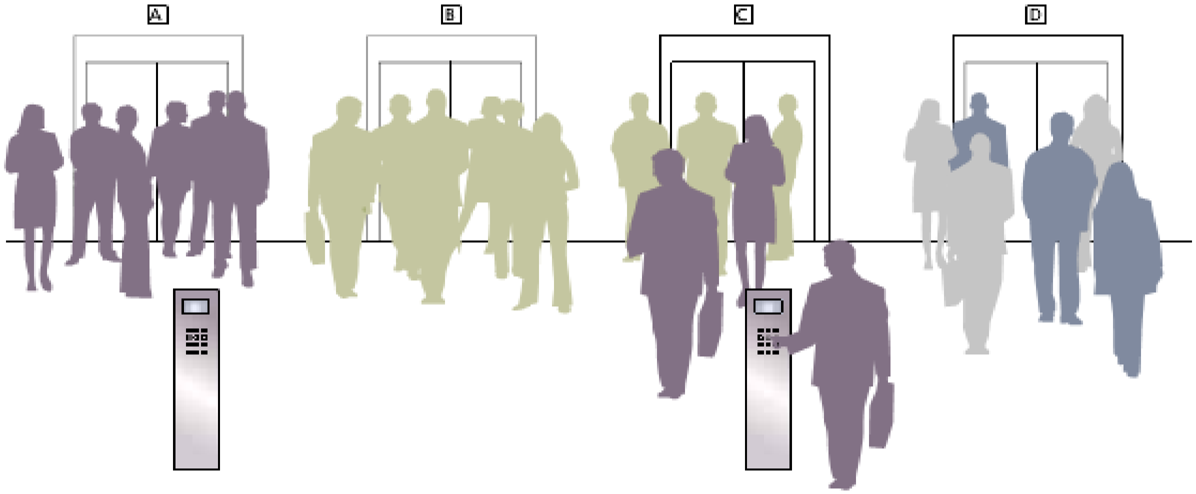
This development led to exciting times.
As designers and architects began to appreciate the possibilities offered by elevators, much higher buildings became feasible, eventually leading to the enormous skyscrapers of today

Evolution Case 2: The Development of Elevators

Conventional operation

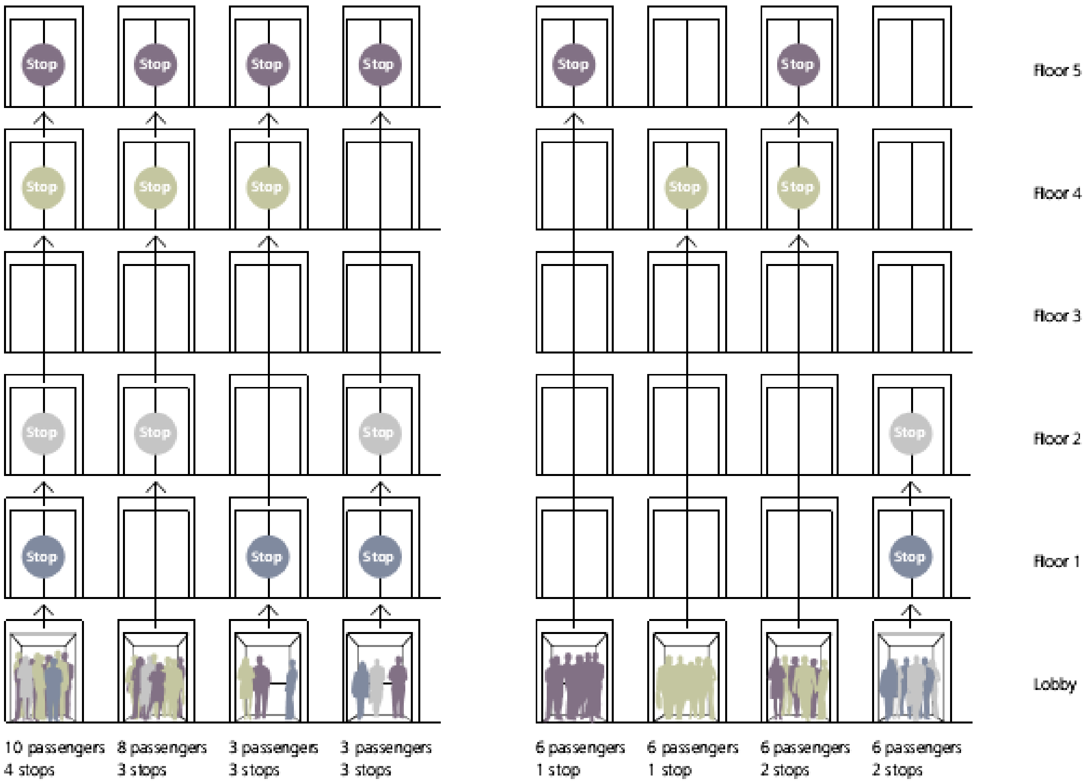


Schindler 7000 Traffic Management System



Schindler 7000 Traffic Management System is a powerful and unique control system based on a simple principle: to bring passengers to their destinations faster, with less crowding and more comfort than any conventional elevator system.

The system's advanced software drives a powerful logic program that systematically optimizes the elevator traffic flow. It uses a sophisticated algorithm to manage the complexities of traffic patterns as they change through the day.



The traditional way

In this simplified example of a classic up-peak situation, over a period of a few seconds 24 people call elevators to travel from the lobby to various different floors.

With the conventional control, the first 10 people cram themselves into the first available car. The next 8 fill up the second, and the few remaining occupy the other cars.

This random behavior by passengers means that every car makes multiple stops, so journey times are lengthened. And most passengers suffer

The intelligent way

Schindler 7000 Traffic Management System knows not only that the maximum comfortable car load is 6 persons, but also that floors 4 and 5 have the highest density of calls in up-peak traffic.

Schindler 7000 Traffic Management System directs the 6 passengers traveling to each of the two busy floors to individually assigned cars, and optimally distributes the others.

As a result, the system ensures that all of the passengers experience a fast one- or two-stop ride, no one suffers overcrowding, and time to destination is shorter.

Evolution Case 2: The Development of Elevators

Evolution Case 3: The Development of Washing Machine

Another example is a washing machine. Drum is driven by electric motor. Water and soap are added to load and the machine is switched on. It might contain an electric heater. Spinning is done but this is not a mechatronic system.

In 1937 the first automatic washing machine was released by Bendix Corp.

In 1947 the top loading automatic washing machine was released by General Electric

In 1957 the technology with water temperature control, rocking speed and engine speed, was equipped with a squeezer and dryer

Evolution Case 3: The Development of Washing Machine

Automatic washing machines have integrated sensors, controllers and programmer to measure the load. The system uses selonoid valves to fill and drain the drum. It has level and temperature sensors, weight sensor and speed sensors. Depending on programme, these are all processed to activate the power control and speed of the motor. This is a good example of mechatronic system

Evolution Case 3: The Development of Washing Machine

Physical integration

Interpenetration of mechanical and electronic supports (with embedded control and software functions)

Considering distributed mechanical and electronic supports connected with wires, a first integration step consists of embedding electronic devices in the mechanical assembly, with the objective of achieving full integration, defined as the “fusion” of mechanic al and electronic support in a single physical unit.

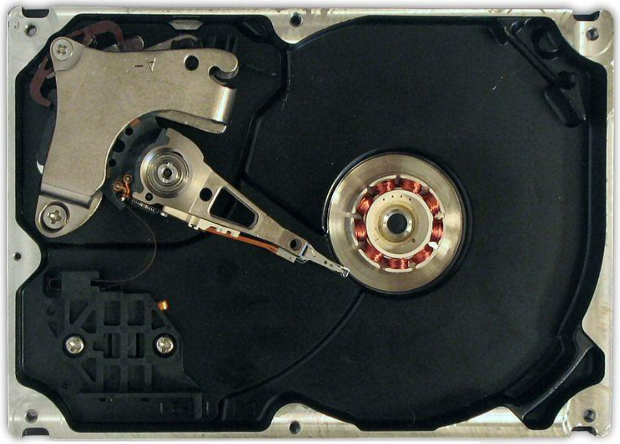
Functional integration

Enhancement of basic mechanical functions with detection, communication, information processing and feedback functions.

1. **feedback** has to be understood as the ability of a product to react to an external stimulus; this reaction can be achieved by different means, for instance regulation (automatic control), closed-loop control, sequential or combinatory logic.
2. several **functional integration levels** can be defined depending on the degree of autonomy which is reached.

Specific Topics of Mechatronics Engineering

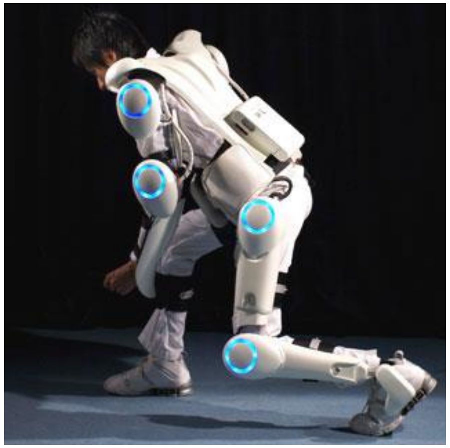
- modeling and design
- motion control
- system integration
- vibration and noise control
- actuators and sensors
- micro devices and optoelectronic systems
- intelligent control
- automotive systems
- robotics
- manufacturing



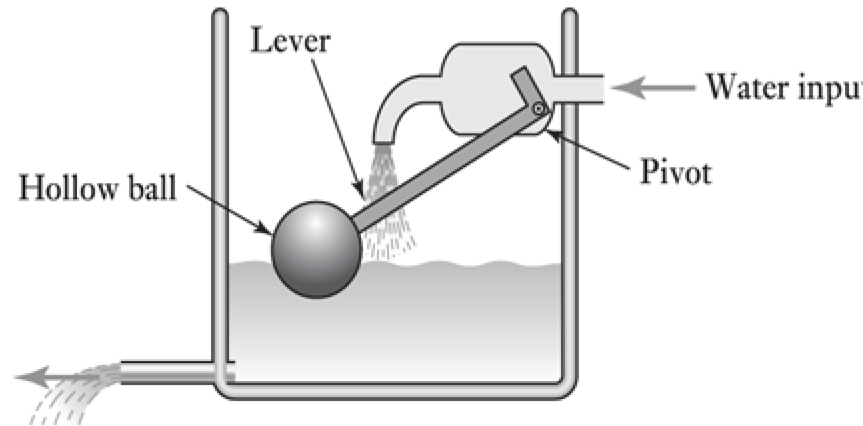

Canon
EOS
5000

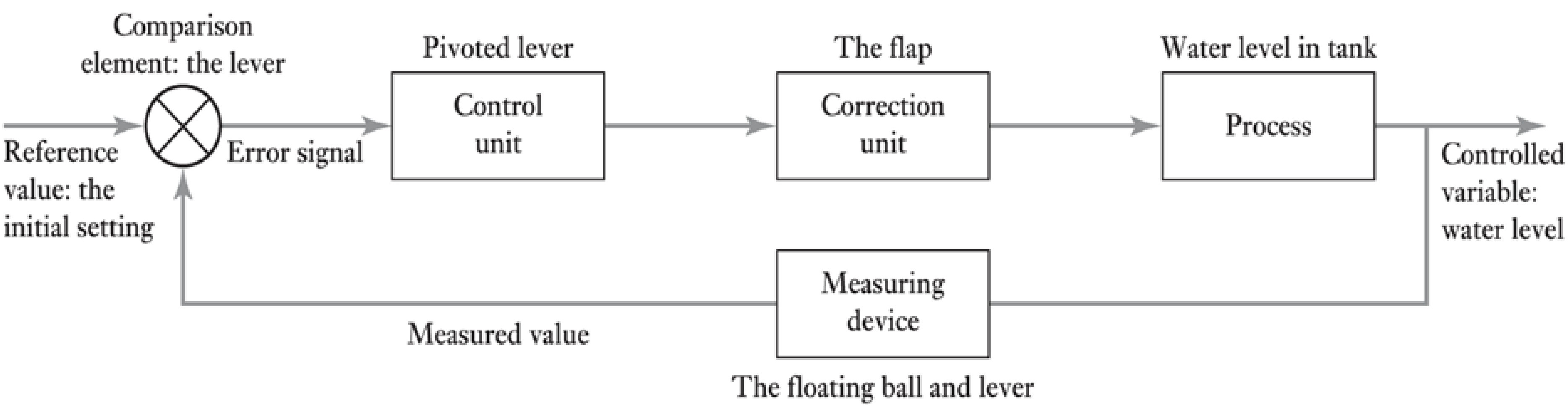

eurobots


HUGIN



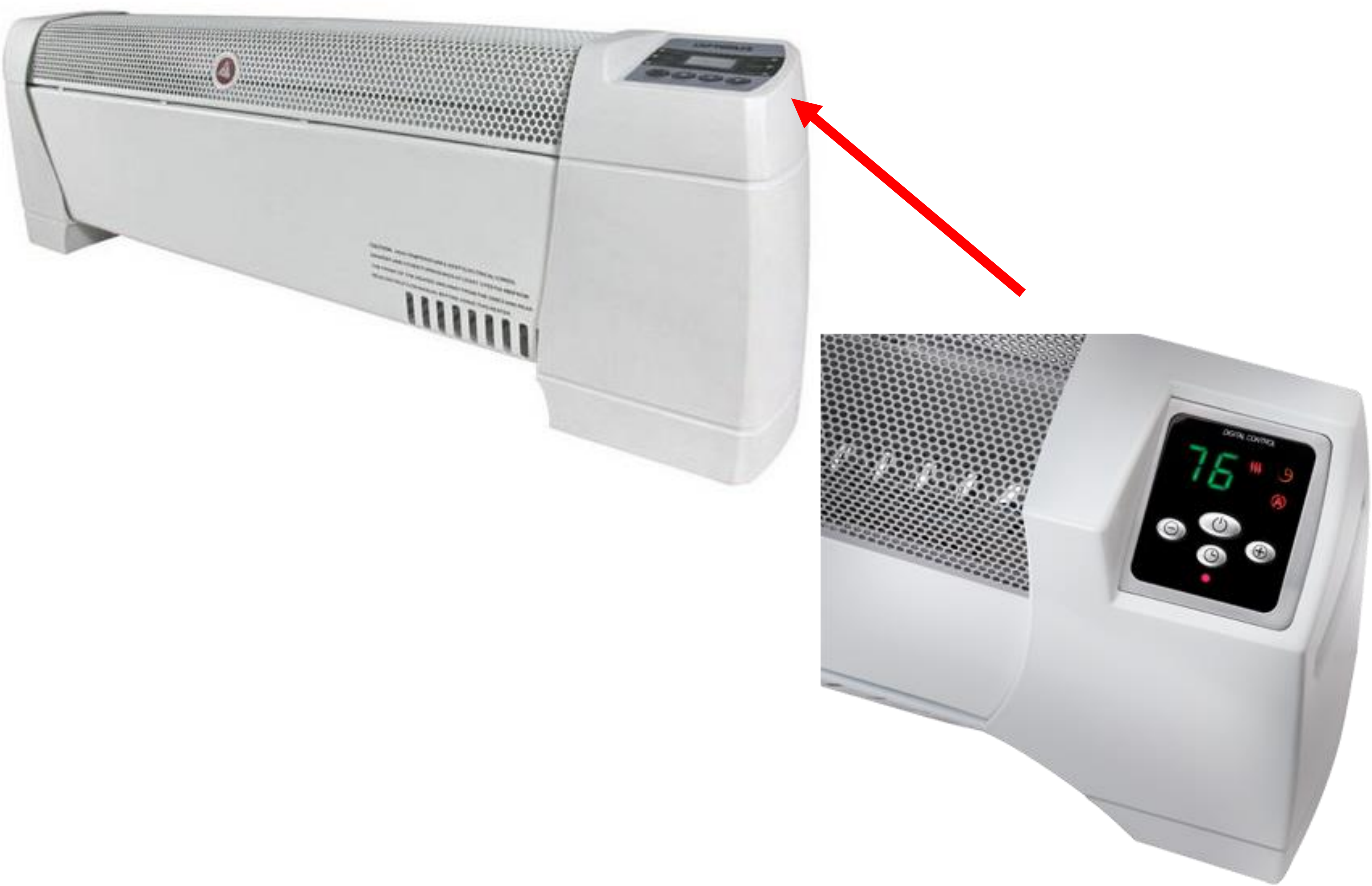
Case: Mechanical Control

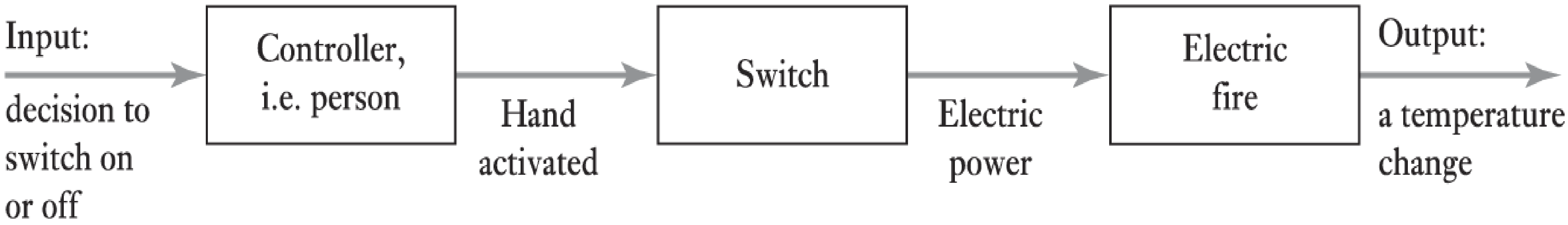




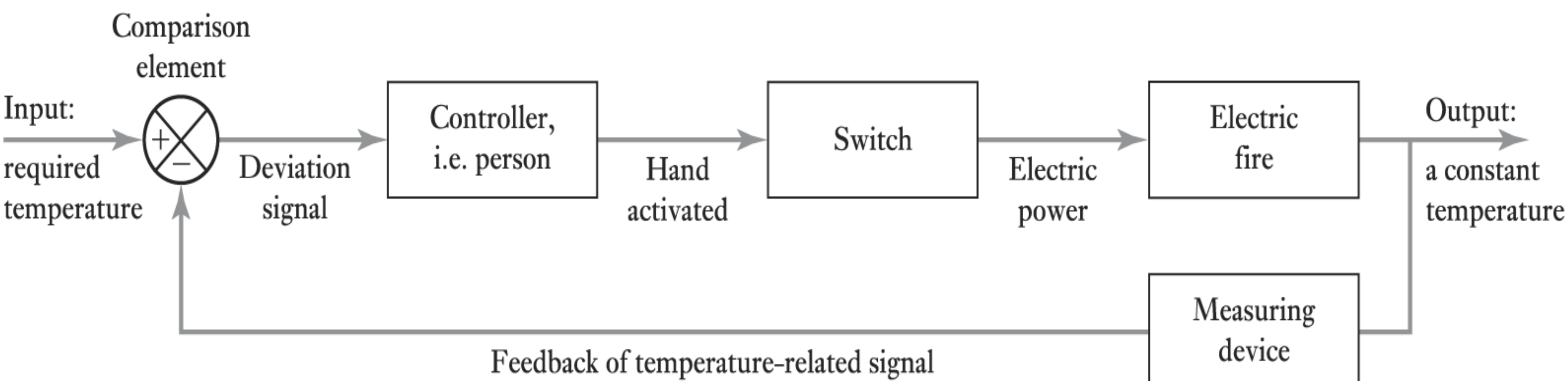
The automatic control of water level

Example Case: Heating a Room





(a)

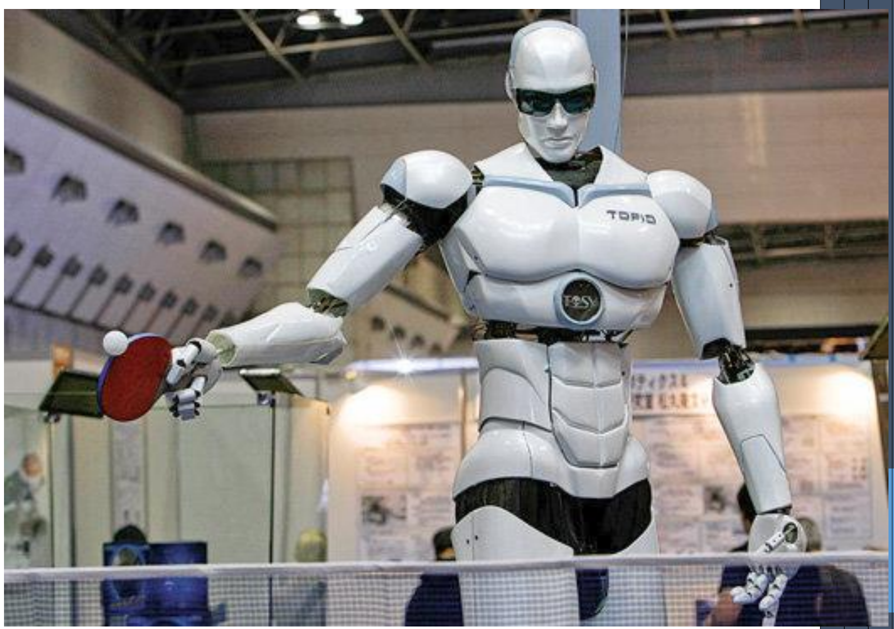


(b)

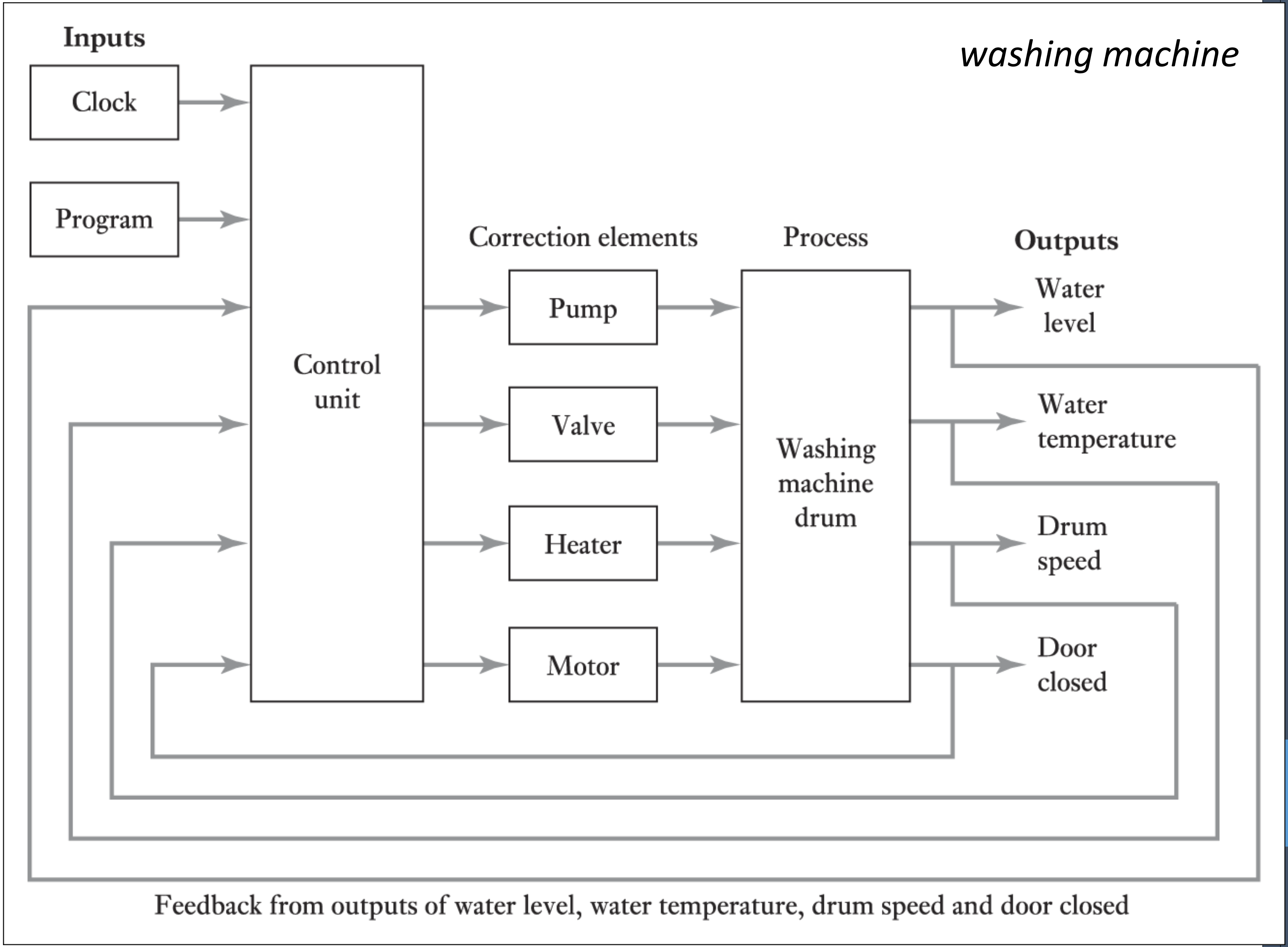
Heating a room (a) an open-loop system, (b) a closed-loop system

Smart machines

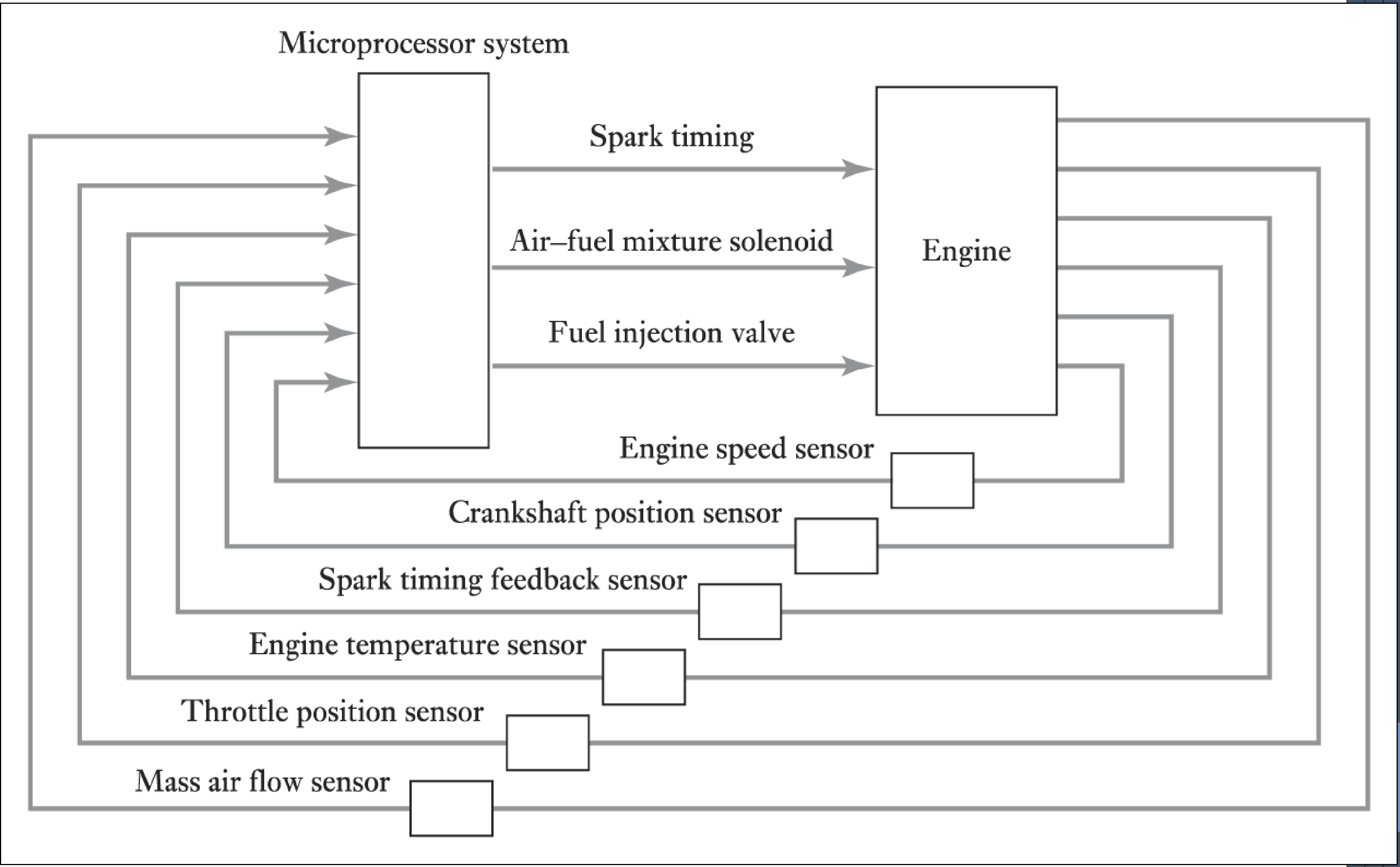
Smart machines sense the enviroment through their sensors and adjust their actions to accomplish the given tasks against to the uncertainty.



Decision making machines



Decision making machines



internal combustion engine

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