An Overview of History of Robotics with an Eye to the Future

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The historical background

can be used as guidance for future successful developments

- when design data and requirements are recognized from historical well established needs, problems and applications,
- which can be re-formulated through modern means for modern solutions.

Robotics is usually referred as
a novel interdisciplinary Engineering Science and Technology
that has been developed in the second half of the XXth century.

But are the concepts dealing with robots and robotized systems really innovative?

The things become old and are often destroyed to renew;
but some day they become suddenly antique and worthy to be preserved,
since they also indicate trace of the evolution.

Usually, the antiquity level is reached after human generations, but nowadays and mainly in Robotics a design is antique just after ten years!

this is an attempt
to outline the evolution of technical culture to modern Robotics

TERMINOLOGY

It is well known that the word “robot” was coined by Karel Capek in 1921 for a theatre play dealing with cybernetic workers, replacing humans in heavy work.

even in today life-time
robots are intended with a wide concern that includes any system that can operate autonomously for given class of tasks.

From technical viewpoint

In 1988 the International Standard Organization gives, [3]:

“An industrial robot is an automatic, servo-controlled, freely programmable, multipurpose manipulator, with several axes, for the handling of work pieces, tools or special devices. Variably programmed operations make possible the execution of a multiplicity of tasks”.

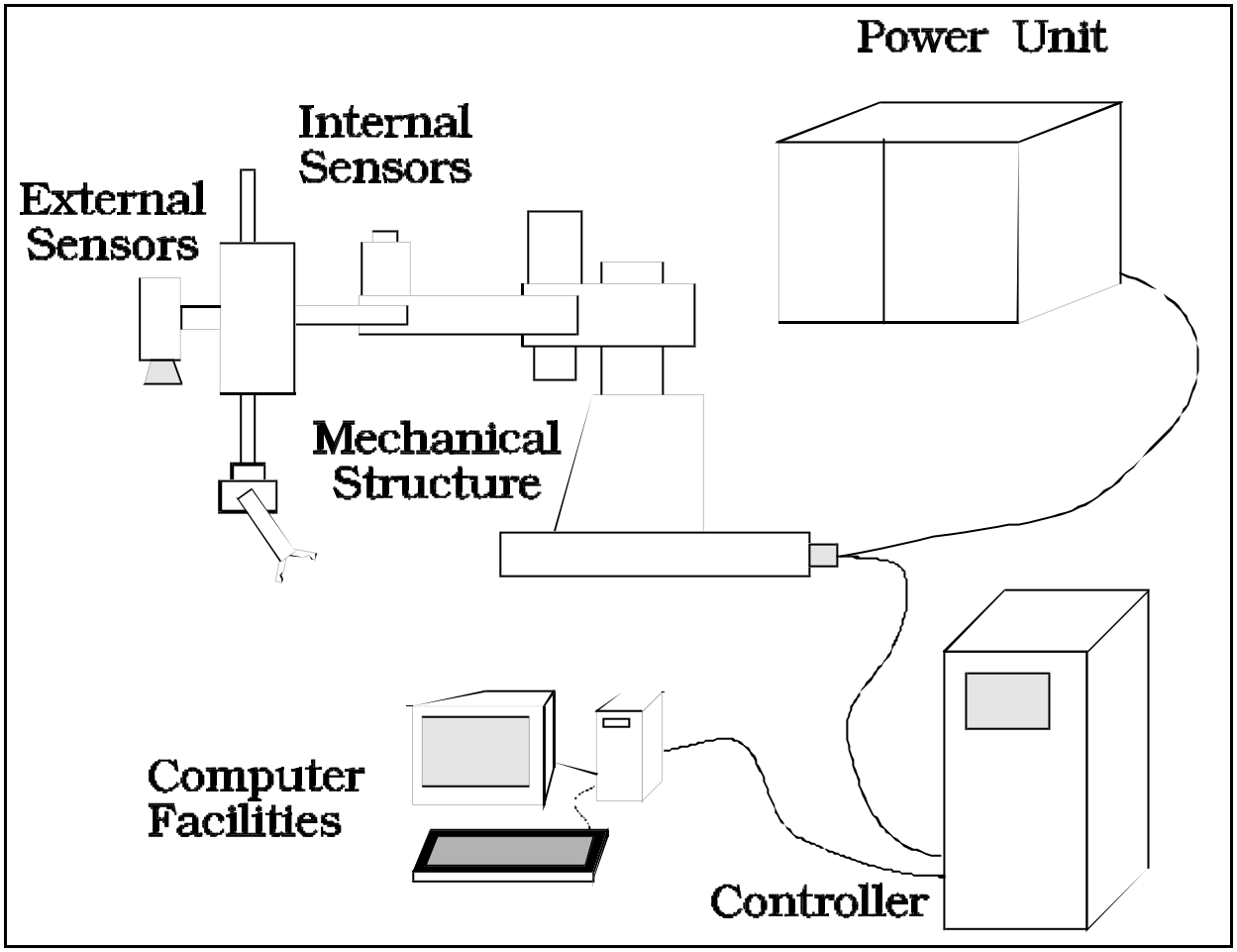
However, still in 1991 IFToMM gives its own definitions, [4]:

Robot as “Mechanical system under automatic control that performs operations such as handling and locomotion”; and Manipulator as ”Device for gripping and controlled movements of objects”.

Even roboticists

use their own definitions for robots to emphasize some peculiarities, as for example from IEEE Community in 2000, [5]:

“a robot is a machine constructed as an assemblage of joined links so that they can be articulated into desired positions by a programmable controller and precision actuators to perform a variety of tasks”.



Nevertheless, a robot or robotic system can be recognized when it has the three main characteristics: mechanical versatility, reprogramming capacity, and intelligent capability

However, still the word automata can be conveniently used in many cases, when the semantic meaning “Acting of itself “ is fully understood.

II. ROBOTS IN ANTIQUITY

The idea of a substitute/help in heavy /unpleasant work

can be found since the beginning of humanity.

Substitutes of human beings were also considered in Antiquity.

Slaves were the first efficient intelligent solutions!

But also artificial solutions were considered,
mainly from theoretical viewpoint, although machines and devices were evolved greatly in Antiquity to help in several activity and establishing a technical culture.

In VIIIth century B.C.,

- in the 18th book of Iliad Homer describes artificial maidservants that are built by Vulcan for the service of Gods: they are mobile by using wheels, are nicely human shape, are able to speak and with some intelligence.

- in Homeric time the idea of robot (properly automaton) for doing practical work, even for manufacturing purposes, was not considered altogether impossible, but within the human reach.

This aim of astonishing the reader was quite common in the Greek Theatre
that made use regularly of automatons and automatic machines in some extent.
Emblematic are those that are mentioned by Aeschylus for the plays, and later on by Aristophan.

The engineering of theatre machines was persistent in Antiquity in Greece and in the Roman Empire.
Greeks reached highs in knowledge even in technical fields.

- Emblematic example is the School of Alexandria in Egypt where since the IIIth century B.C. there was an intense activity in teaching and research also on automatic devices.

A brilliant example is the work by Heron of Alexandria
who, in particular, treated in depth Pneumatics and Automatic mechanisms for several applications.

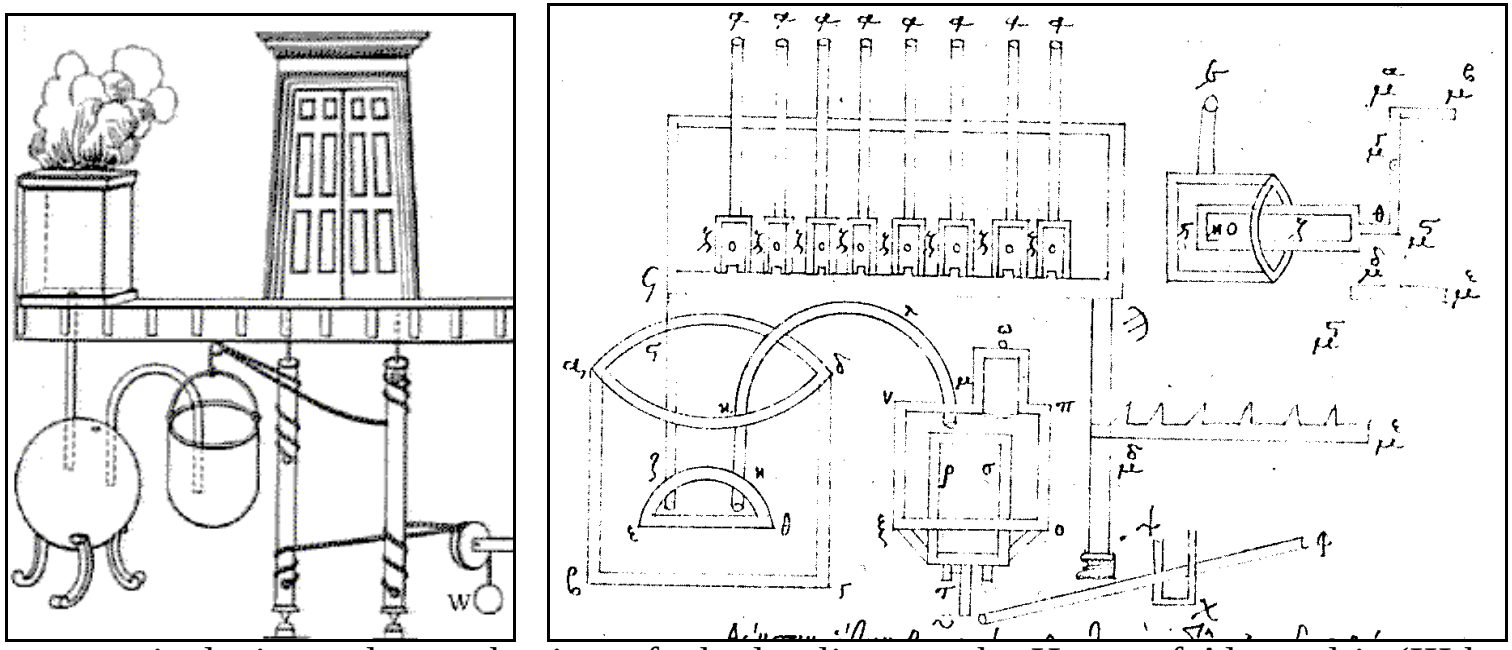


Fig. 1: An automatic device and a mechanism of a hydraulic organ by Heron of Alexandria (IIIth cent. B.C.)

The Romans developed further a technical culture

- They conceived and built several machines that could help humans in the work, although they made extensive use of slaves as perfect robots, since sometimes they were used as machinery without any moral attention.

A brilliant example is

Vitruvius, who lived in 1st century a. C. and wrote an Encyclopedic Treatise "De Architectura" that was rediscovered and used since Renaissance again.

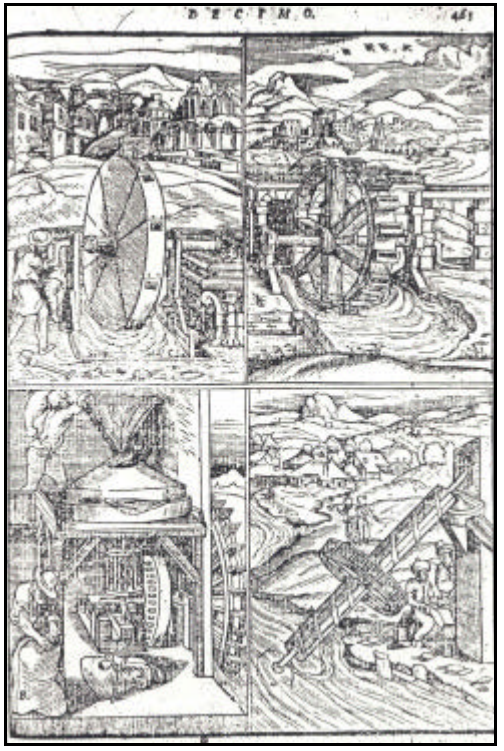


Fig.1: A catalogue of mechanisms in Antiquity as reproduced during the Renaissance from the work by Vitruvius

But technological evolution was important

not only in today western world.

For example, in China the culture reached highs that needed also mature Technology.

In the field of automation Chinese designers developed brilliant solutions, whose a very significant example is the Wood Cow of Fig.2, [7], that was used for transportation purposes of heavy loads by using 1 degree of freedom walking machine.

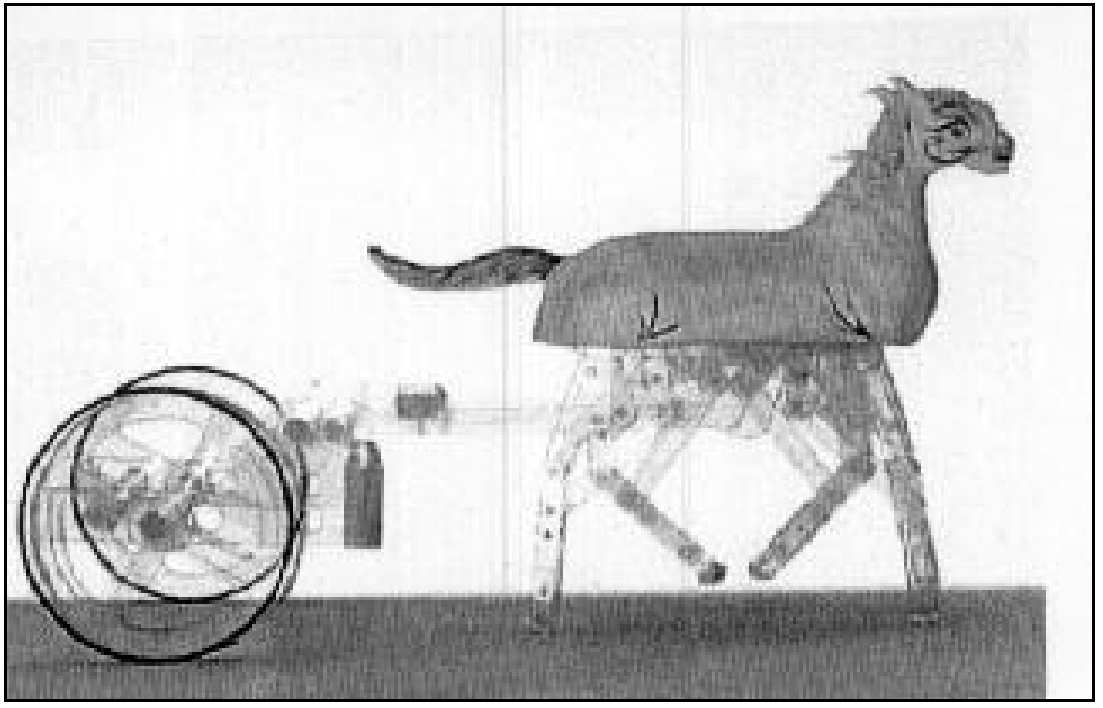
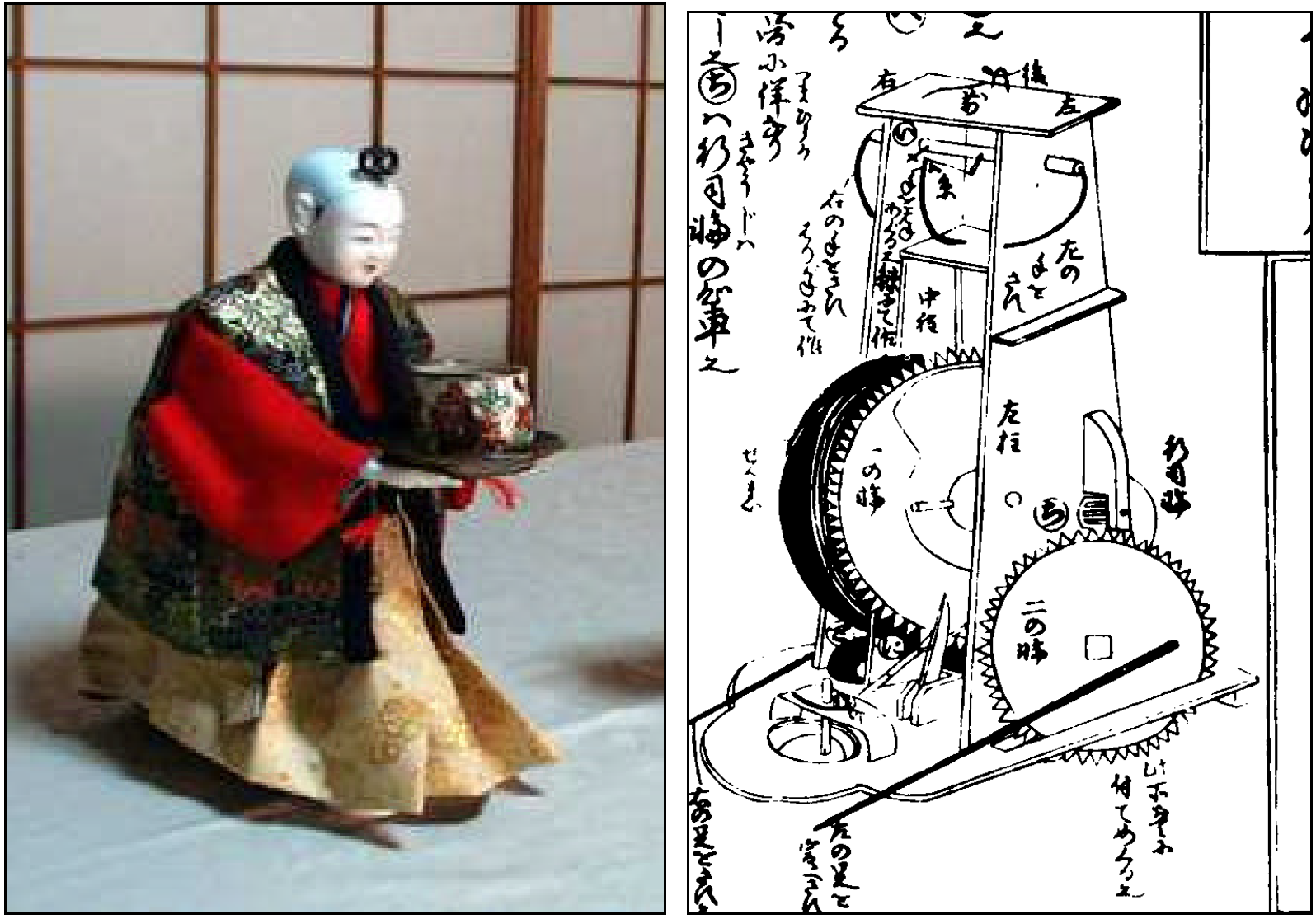


Fig. 2: The Chinese Wood Cow built in Vth cent. B.C.
(from Ancient Chines Machines Foundation at National Cheng Kung University in Tainan)



a) b)

Fig. 1.6: The Japanese tea maidservant automaton whose design was developed in the XVIIth century: a) a modern reconstruction; b) an original design scheme.