

# The Use of Mechatronics and Microcontrollers in Mechanical Engineering

Jayakrishnan Nair M.

Lecturer in Automobile Engineering, S. N. Polytechnic College Kanhangad, Kerala, India

**ABSTRACT:** Mechanical engineering was one of the most professional branches that grew rapidly in the early nineteenth century, as it was the backbone of industrial growth and revolution. However, as technology advanced and productivity increased, mechanical found it difficult to meet the demands, whims, and fancies of their customers. As a result, it employed electronics engineering, giving birth to the most spectacular and astounding branch of engineering known as mechatronics. Mechatronics is a synthesis of mechanical, electrical, and computer science. Automobiles, robotics, pumps, and many other applications use mechatronics. The goal is to create smart products and "intelligent" machines. Software is an essential component of such products and machines, and it can be considered a machine element. This paper defines mechatronics systems and their applications.

**KEYWORDS:** Mechatronics, Microcontroller, Mechanical Engineering, Automobiles, mechatronics system.

## I. INTRODUCTION

With the increasing use of digital control of mechanical systems, mechanical engineering students must have a basic understanding of microcontrollers and microprocessors, as well as their associated interfaces with the mechanical world. As a result, microcontroller courses have been introduced in many universities. The didactical equipment used to achieve this goal can be costly. On the other hand, there are cases where existing equipment can be improved by using microcontrollers and a PC. Microcontroller-based devices and appliances can be found in almost every aspect of our daily lives. [1] Even the auto industry, a traditional mechanical engineering fiefdom, is putting tens of microcontrollers in a modern vehicle and plans to multiply this number as new technologies are introduced.



### **Mechatronic systems and mechatronics**

Since the 1990s, Mechatronics has been recognised as a multidisciplinary engineering discipline concerned with the complexity of modern systems. Mechatronics is defined as a synthesis of the disciplines Mechanics, Electronics, Electric Engineering, Control, Measurement, and Computer Science, as illustrated in Fig.1.

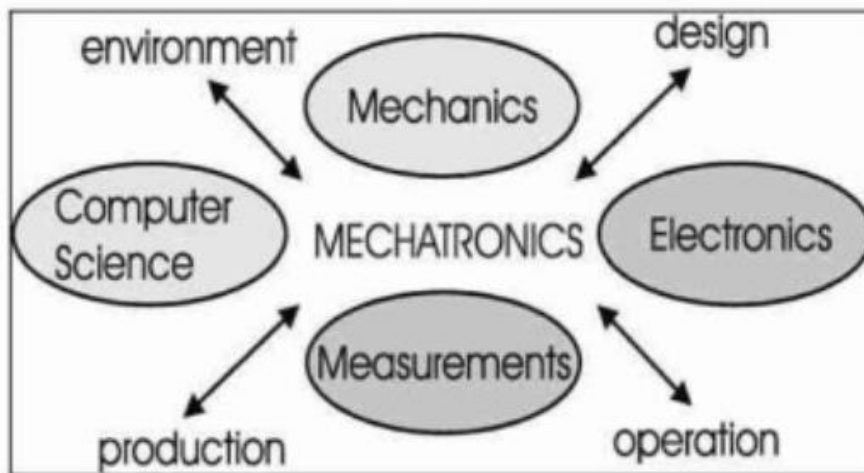


Fig. 1 A scheme for definition of Mechatronics

A mechatronics system is made up of mechanical parts, electric devices, electronics components, sensors, and hardware, and it is operated and controlled by supervisors and commands programmed using appropriate software. [2] Thus, the integration and complementarities of various aspects from various disciplines that describe the design and operation of the components and overall system are the main characteristics of mechatronics systems. Furthermore, for a suitable operation of a mechatronic system, engineering issues and human-system aspects must be considered, such as features and constraints from the environment in which the system operates, the design by which it was developed, the operation performance by which it fulfilled the task, and the production by which it was built.

### Micro-Controllers

Microcontrollers (as opposed to PCs) are becoming increasingly important in industrial products because they provide functionality at a lower cost. They are portable and less expensive, and most importantly, they provide students with real-world experience. When microcontrollers are used in the laboratory, however, several issues arise. Because most mechatronic systems are typically the domain of electrical engineering and computer science students, the intensive programming required by microcontrollers has not been a problem. Most mechatronics education has traditionally placed a strong emphasis on microcontrollers and programming. [3] We believe that the emphasis on programming distracts from conveying the main analysis and design concepts, particularly in mechanical engineering curricula.

### Functions of mechatronics

Essentially, the major function in a mechatronic system is the capability of sensing changes in the real-world environment to assist mechatronic systems in achieving desired actions of a mechanical component, or the technological constraints required in a specific manufacturing process. Many improved and smart functions are available in modern mechatronic systems, such as the estimation of non-measurable variables, self-tuning and adaptation of controller parameters, reconfiguration, supervision and fault diagnosis, safety and fault tolerance. [4] Many autonomic functions, such as reconfigurability, self-organization, self-repair, autonomous evolution, and self-replication, will be implemented in the future.

### Elements of mechatronics system

Various elements of typical mechatronic systems are depicted and described below.

- Actuators and Sensors
- Signals and conditioning
- Digital logic systems
- Software and Data Acquisition systems
- Computers and Display devices.

### Hardware for mechatronics/microcontroller education

The hardware issue is also complicated by the wide range of microcontroller options available on the market.

### **The Microcontroller Evaluation Board (EVB)**

Microcontrollers are typically used in single chip mode for embedded applications. In embedded applications, the programme is already "burned" into the microcontroller's ROM memory. The user only needs to place the microcontroller in its proper location to turn it on and start the programme. The microcontroller will then run on its own. The programme is stored in ROM during the fabrication process. [5]

The microcontroller must be used in conjunction with a host computer (PC) and/or a terminal for code development applications. The programme can be written on the host computer and then tested on the microcontroller. Alternatively, the programmer can use the terminal interface to develop the programme directly on the microcontroller. This process's electronic circuitry and IC chips are mounted on an evaluation board (EVB). The EVB includes expanded memory chips, a port replacement unit, and IC chips for connecting to a host computer and/or a terminal. The EVB is required for programme development because it allows the software programmer to create and test microcontroller application software. After developing and testing the microcontroller application software, it will be "burned" into the ROM of mass production microcontrollers. The EVB expanded system, which includes an MC68HC24 and a PC, allows the user to create software for either single-chip mode or expanded mode microcontroller applications. [6] There are several commercially available microcontroller evaluation boards. They range in complexity from simple to complex.

### **Software for mechatronics/microcontroller education**

The software issue is particularly difficult because mechanical engineering students are not taught script programming until they enrol in the microcontroller course. Today, the majority of mechanical engineering students' programming education is done in visual languages such as MathCad and LabView, for which the College has site licences. As a result, teaching a script language such as Assembly or C++ for programming the microcontroller must begin with fundamentals. We discovered that using microcontroller simulation software significantly improves students' ability to climb this steep learning curve.

### **Future mechatronics systems**

We believe that future mechatronic systems will be made up of several autonomously acting agents capable of monitoring their own physical environment and exchanging data with other agents. The presence of this additional information will open up completely new avenues for adaptation via networked control technology, going far beyond what software control in mechatronic systems is currently capable of. This trend is bolstered further by the development of new networking technology, such as wireless sensor networks (WSN). [7] Such techniques will enhance mechatronic systems' sensing and control capabilities. WSN is difficult on its own because it necessitates an enormous breadth of knowledge from an enormous variety of disciplines. [8]

### **Objectives**

- investigate the need for mechatronics
- investigate the hardware, software, and components of a mechatronics system
- investigate mechatronic actuation

## **II. RESEARCH METHODOLOGY**

Methodology is the systematic, theoretical examination of the methods used in a particular field of study. It consists of a theoretical examination of the body of methods and principles associated with a particular field of knowledge. It usually includes terms like paradigm, theoretical model, phases, and quantitative or qualitative techniques. A close reading and detailed analysis of secondary sources is required in order to apply the analytical and descriptive methods to the research. It is critical to obtain additional perspectives in order to expand on the textual analysis, which would necessitate close reading analysis of a few secondary materials.

## **III. RESULT AND DISCUSSION**

Calculators have evolved even further, and the complicated pure mechanical systems that were conceived in the 18th century have all but vanished, with only informatics and electronic hardware being used for calculators up to 100% of the time. [9] The only mechanical parts with pure mechanical operations are the key buttons in keyboards that are pushed by a human user's fingers. The preceding points are summarised in the schemes in Figs. 2 and 3 as they relate to a general layout and model for a mechatronic design involving a servo-controlled actuator. [10-12]

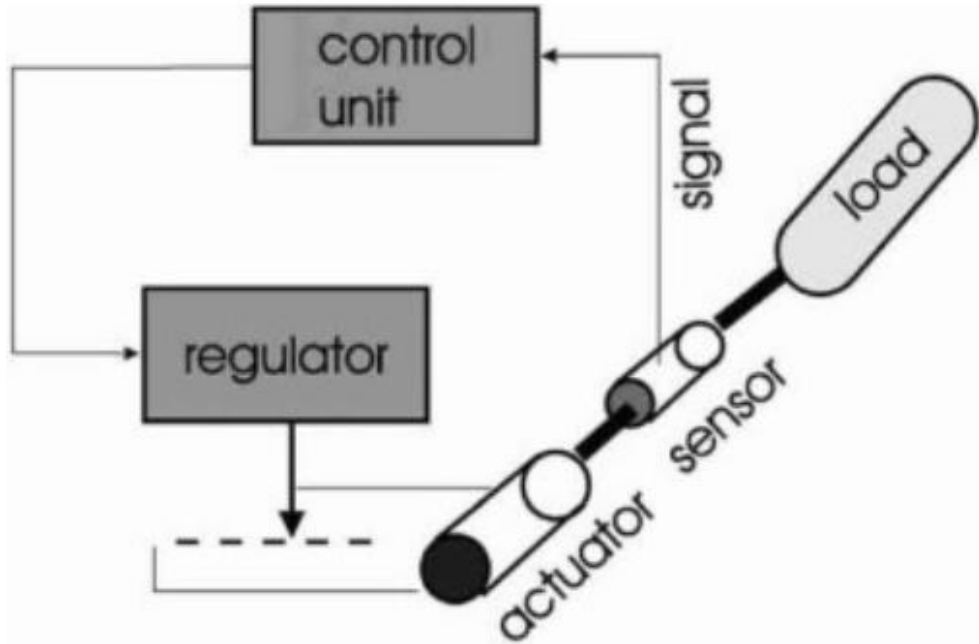


Fig. 2 A mechatronic design for a manipulator actuator

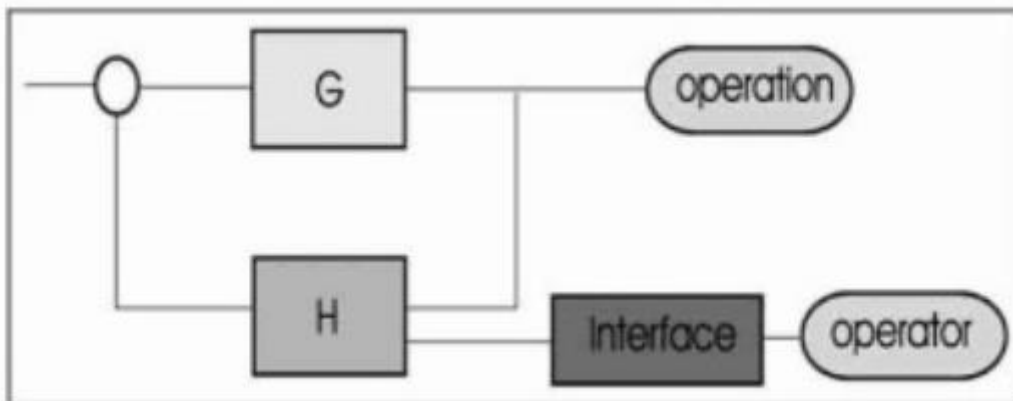


Fig. 3 A block diagram for mechatronic actuation

Diagrammatic Representations of Mechatronics is as shown in below fig.

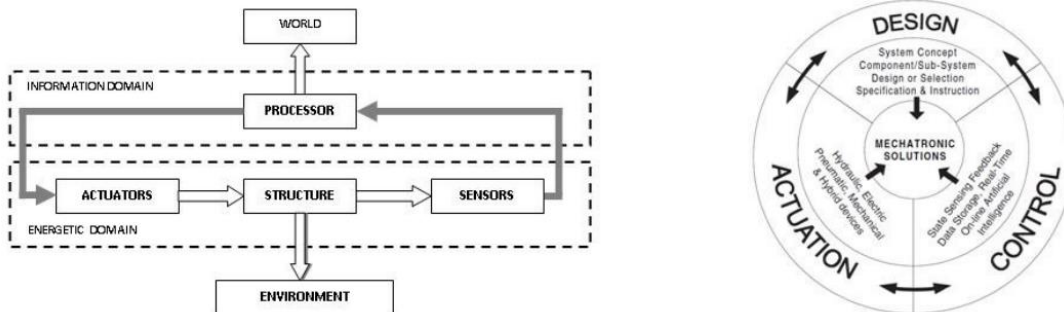


Fig. 4 Diagrammatic Representations of Mechatronics

Figure 5 depicts automotive mechatronic systems such as electric fuel injection, anti-lock braking, cruise control, and tyre pressure monitoring systems. [13-14] In addition, research and development work on future automotive applications of mechatronic systems such as advanced braking systems, steer-by-wire or wireless techniques, and active

suspension systems is underway. These advancements are likely to become standard features in modern production vehicles in the near future. [15-16]

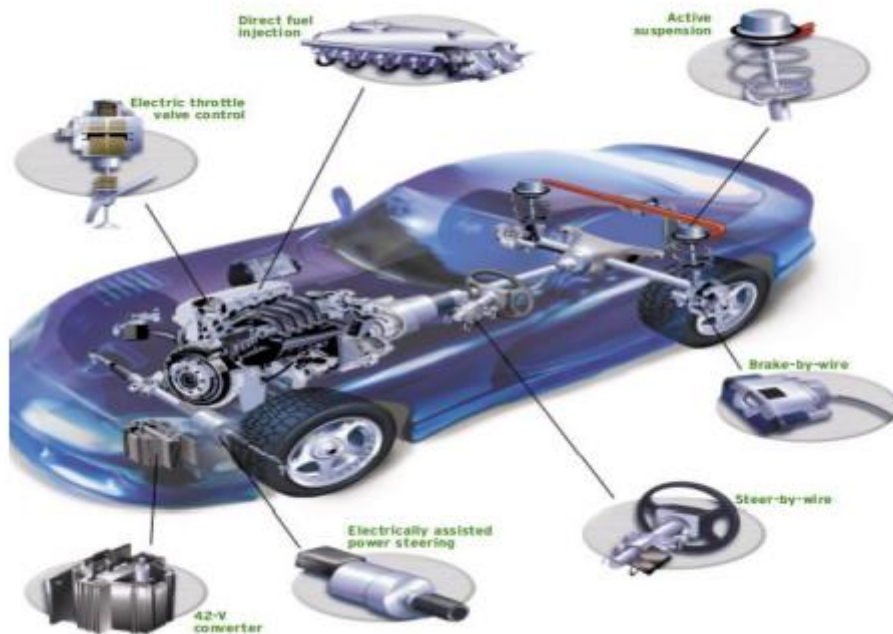


Fig.5 Mechatronic systems in cars

#### IV. CONCLUSION

We provide a brief overview of mechatronics systems in this paper. Mechatronics engineering is a new engineering discipline that combines mechanical engineering, electronic engineering, software engineering, computer engineering, control engineering, and system design engineering. This new engineering field seeks to produce an all-around engineer capable of performing virtually all engineering activities in industries such as machine vision, automotive engineering, computer aided design, sensing and control systems, mobile applications, and robotics. The use of microcontrollers and PCs is required to facilitate mechatronics education. We have provided a balance between the understanding of design concepts and the knowledge of real-life implementation of data acquisition and control in mechatronics as a mechanical engineering department.

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