Prospect and Requirement of Mechatronics Education in Bangladesh

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Abstract

Today's engineering systems require multi-disciplinary design teams. In addition, the computer tends to now be an integral component of these complex systems. For a developing country like Bangladesh evaluation of importance of mechatronics education is need of the time. This paper meets the perspective first discussing the general ideas regarding the mechatronics concepts. It then introduces the prospect and fields of application of mechatronics system in Bangladesh. Finally requirement for mechatronics education system is converted into an outline of mechatronics course which would meet such perspective.

Keywords

Mechatronics

Definition, objectives and future

Mechatronics is an interdisciplinary field of engineering and also a design methodology. The field of mechatronics has been described as an intersection of the engineering areas of control systems, electronic systems, mechanical systems as well as computers. Control theory contributes feedback design and stability analysis. The controller is part of a loop for continuous operation in a particular environment resulting in a need for real-time interfacing for analyzing analog, digital and frequency signals. Mechanical engineering donates design, manufacturing and system dynamics. The study of mechanical systems also involves kinematic and dynamic analysis. Computer science/engineering supplies data acquisition methods and algorithms. Information systems tools are necessary for modeling and simulation, automatic control as well as optimization. Modeling and simulating a system before construction is important in order to reduce costs and anticipate potential problems in the implementation phase. Electronic aspects include the actuators and sensors which help interface the system to the outside world. Electrical areas of study include DC and AC circuit analysis, power as well as semiconductor device analysis. Sensors can be as simple as sonar, touch, and thermistor or as complicated as vision. Actuators can include stepper motors, DC and AC motors, servo, hydraulic, pneumatic and possibly other unconventional types. In general, the mechatronics design process is typically iterative, and this is exemplified by multi-disciplinary trade-offs.

There are many systems in the existing world that require a synergy of these expertise areas including systems in automotive, aerospace, medical, materials processing, manufacturing and the consumer products application sectors. Some examples of mechatronics systems include aircraft flight control and navigation systems, automobile electronic fuel injection and anti-brake systems, automated manufacturing equipment (e.g., robots, numerically controlled machinery), as well as smart kitchen and home appliances (e.g. bread machines, washers, dryers, toys). The field of robotics can be considered to be a subfield of mechatronics. The typical components of a robotic system include the actuator, communicator, control computer, end-

effector, manipulator, power supply as well as sensors. An excellent example of a common mechatronics system is the photocopy machine. Analog circuits are used to control the lamp, heater and power. Digital circuits control the digital displays and indicator lights. Buttons and switches are used for the user interface. Optical sensors and micro-switches are used to detect the presence or absence of paper as well as the correct positioning of the paper. Encoders also track the motor rotation for the various drums that guide the paper through the machine. The actuators include the servo and stepper motors that load and transport the paper, turn the drum and index the sorter. All of these complex interactions are transparent to the eventual user of the system; typically, a mechatronics design goal for any mechatronics systems.

The life cycle for mechatronics design requires addressing:
(1) Delivery parameters such as time, cost and medium;
(2) Reliability issues such as failure rates, materials and tolerances;
(3) Maintainability, which necessitates modular design;
(4) Serviceability protocols and methods such as on-board diagnostics, prognostics and again modular design;
(5) Upgradeability; and
(6) Disposability processes including recycling and disposal of hazardous materials.

A computer-aided prototyping environment should provide the tools necessary for modeling, simulation, project management, design, analysis (as well as synthesis), real-time interface, code generator and embedded processor interface. The key to success for any mechatronics system is to strike a balance between:
(i) Modeling, analysis, control design, computer simulation of dynamic systems; and
(ii) Experimental validation of models, analysis and understanding key issues of hardware implementation.

The above-mentioned definition that mechatronics is just the combined technologies from different areas will not be enough to explain the mechatronics. Even if a system includes only electronics, in some cases we can call it as a mechatronics product, which is like an electronic watch consisting of only electronic components. Looking at the history of mechatronics, we can see that the mechatronics is relating to a kind of effort of solving technological problems using interdisciplinary knowledge among mechanical engineering, electronics, and computer technology. To solve the problems, traditional engineers used some knowledge provided only in a traditional individual area, like mechanical engineering, electrical engineering and so on. For example, a mechanical engineer used some ways described in the textbook of mechanical engineering to solve the problem. In 1970s, because of the increase of the difficult technical problems to be solved and also needs of having more advanced products, researchers and engineers were required to find novel solutions for them in their R&D. This motivated them to look at different area’s knowledge and technologies to develop a new product. For example, mechanical engineer tried to introduce electronics to solve the mechanical problem given to them. The advancement of micro processor also contributed to encouraging the motivation. As the results, they could consider the solution to the problems with wider views and more efficient tools and result in obtaining new products based on the integration of interdisciplinary technologies and/or replacement between interdisciplinary technologies. From those observations of the mechatronics history, how to integrate the different technologies to obtain the best solution to a given technological problem

is considered to be an essence of the mechatronics. With this in mind, my talk will discuss what kinds of technology integration have been proposed in mechatronics. First, four traditional ways of integration will be addressed with some successful products developed in each way. New technological seeds also increase components which we can use for the integration and result in producing new ways of integration. Especially, computer networks and functional materials will provide new tools for designing new mechatronics products and systems.

Prospects of Mechatronics Education in Bangladesh

The mechatronics was born in Bangladesh about five years ago which is an interdisciplinary area relating to the mechanical engineering, electrical engineering/electronics and computer science. This technology has produced many new products and provided powerful ways of improving the efficiency of the products we use in our daily life. Currently, there is no doubt about the importance of the mechatronics as an area in science and technology. However, it seems that mechatronics is not clearly understood, though the word is popularly used in the world and several conferences and books for mechatronics can be found. May be people are thinking mechatronics is a science and technology which deals with a system including mechanisms, electronics, computers, sensors, actuators and so on. It seems that almost people define the area, considering what kinds of components will be included in the system and/or how the mechanical functions are realized by computer software. Such a mechatronics definition makes people feel as if the mechatronics were just the collection of the existing science and technology like mechanisms, actuators, electronics, intelligent control theory, computer technology, fuzzy control, artificial intelligence, micro-machine and so on, and has no original contents as a technology. Currently, several textbooks for mechatronics can be found in the world. Almost all these books seem to consist of several chapters, each of which summarizes the subject picked up from existing technologies. This structure also makes people think that the mechatronics has no unique technology. Also, there is some confusion between mechatronics and some new areas closely relating to computer technology and electronics, robotics, micro-machine and so on.

Fields of Application

A developing country like Bangladesh has many prospects in mechatronics application. Many industries presently working either uses mechatronics system installed by some foreign industries or do not use any. Some of them are non-functional due to the absence of proper technology.

Power plants are a prospective field for mechatronics. Power plants include measurement and control system integrated into the entire plant. Most of the plants use costly mechatronics system installed by foreign companies. Most of the system do not include genration and supply monitoring system. All of these can be improved to be a stable and country wide architechture.

Garment industries is a promising field. Many such industries still uses manual processes which are very rigid for incorporating a mechatronics system. Others involve automated systems which are not integrated. These systems can be combined into a total manufacturing system. Although with respect to current situation use of mechatronics system in garment industries is not well justified.

There are some food processing industries in Bangladesh which requires mechatronics approach for quality product. Moreover personnel with mechatronics knowledge

would be appriciated in these fields for the maintenance and extension of existing mechatronics systems.
Other applications may include chemical industries, household appliances, miscellaneous product design, etc.

Goals And Specific Objectives

The principal goals of the mechatronics curriculum are summarized below:
(i) To develop an innovative curriculum in Electro- Mechanical System Design that will serve as a national model.
(ii) To use this innovative curriculum as a means of integrating electrical, electronic, mechanical, and computational engineering education into a capstone design sequence.
(iii) To introduce the use of video and computers into the classroom and laboratory.
(iv) To emphasize the use of a variety of CAD tools in engineering design and analysis.
(v) To provide a realistic engineering problem setting in the laboratory, enabling the students to address design and experimental issues in engineering.

The means through which these objectives will be accomplished are a sequence of three courses and an open laboratory focusing on the design of electro-mechanical systems. The laboratory will consist of an Electro- Mechanical Systems Laboratory, in which the students will be exposed to the electrical, electronic, mechanical, hydraulic and computational aspects of hybrid systems. Applications that will be studied in this laboratory will include: an electro-magneto-mechanical proportional effort steering system; an anti-lock braking system; a hydraulic load; a flexible shaft with inertia load; and friction loads; hydraulic systems; and electric and hybrid-electric vehicle applications. The students will have a number of experiment stations at their disposal, including a small internal combustion engine, and various electric machines, including induction, synchronous, DC, and switched reluctance motors. Each station will be equipped with a Motorola DSP 56000 Digital Signal Processor that will serve as a general purpose controller. Workstations will also be available for simulation studies and data processing.

The three courses that will form the core sequence of the program are:
Introduction to Mechatronics
Dynamics and Simulation of Electro-Mechanical Systems
Control of Electro-Mechanical Systems

These courses and the laboratory will be integrated into the existing Electrical and Mechanical Engineering curricula, and will culminate in a capstone design project centered around the facilities available in the laboratory. This setting will permit the development of a curriculum in electro-mechanical systems with a focus on real engineering problems for electrical and mechanical engineering students. Through this curriculum we seek to lead the undergraduate students to creatively identify capstone design projects in electro- mechanical systems. The design projects will be realized through the use of open laboratories and with the participation of industrial sponsors, who will assist in defining projects and will provide in-kind and cash support for individual projects.

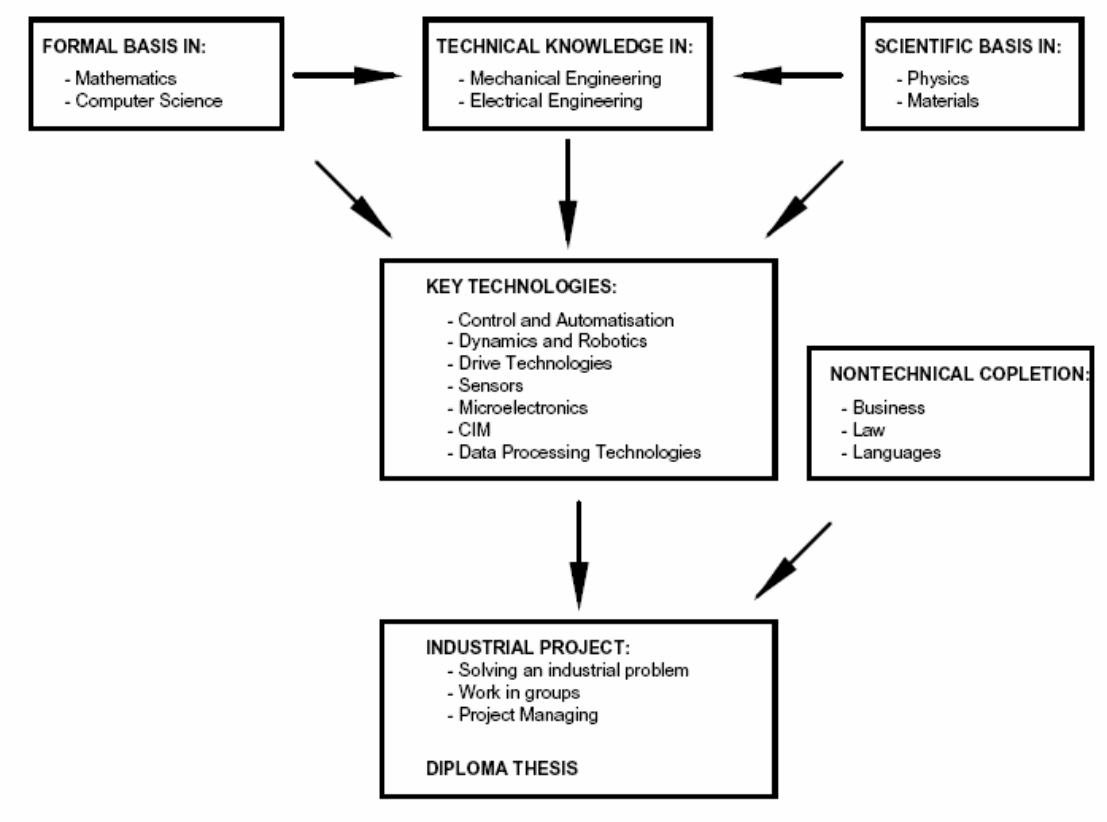

Fig : Outline of a mechatronics course.

Conclusion

The paper focuses on prospects and requrements of mechatronics education in Bangladesh. To cope with the development process of the modern world Bangladesh should come forward with this new engineering field. Where many university of the world has redesigned their curriculum to fit the new world need, Universities of Bangldesh should also consider the changes that they have to consider tomorrow.

Reference

- http://synthesis.org/Mechatronics-Workshop/by_title.html