International Journal of Advanced Mechanical Engineering.
ISSN 2250-3234 Volume 8, Number 1 (2018), pp. 245-250

http://www.ripublication.com

Review on Application Implementation of Advanced Mechatronics in the Arena of Mechanical Engineering

[1]Ashok Kumar Das and [2]Dilip Kumar Bagal

[1]Research Scholar, Department of Mechanical Engineering, Government college of Engineering, Kalahandi, Bhawanipatna, Odisha,
[2]Assistant Professor, Department of Mechanical Engineering, Government college of Engineering, Kalahandi, Bhawanipatna, Odisha, 766002, India.
E-Mail: ashokkavita123@gmail.com , dilipbagal90@gmail.com

Abstract

In recent years, Mechatronics term is being widely used in real world applications. In these past 4-5 years, the mechatronics has been implemented in many appliances such as workshops, vehicles, automobiles and aerospace industries. The parking camera or the rear view cameras and sensor, which make the car to detect the distance in between the two cars. Further, it helps automatically to park the car in between them without any crash. The proposed works revealed that the Dynamo and Piezoelectric Circuit have been implemented in the sections of car which is purely based on Electromagnetic Induction of Faraday's Law. The main strategy is to make such type of car which works by converting mechanical energy into electrical energy. Thereby conserving fuel and electricity which are very much costly and thus it helps the environment free from pollution.

Key points: Camera; Dynamo; Electromagnetic Induction; Mechatronics; Piezoelectric Circuit.

I. Introduction

Mechatronics is multidisciplinary field of science that includes a combination of mechanical engineering, electronics, computer engineering, tele-communications engineering, systems engineering or in other words we can say mechatronics is the combination of mechanics and electronics: as technical systems have became more complicated the definition has been widened to include more technical or scientific areas. The word "mechatronics" originated in Japanese-English and was coined by an engineer of Yaskawa Electric Corporation named Testsuro Mori. The application of

mechatronics had been used widely through globe. Machine Vision, Automation and Robotics, Servo mechanics, Medical Imaging systems and Manufacturing systems the mechatronics are the applications of mechatronics used now a day. In 1971 the word "mechatronics" was registered by the Japan with a register number of "4632714". Hence, the company released the right of using the word "mechatronics", the word spread to the rest of the world. Now the word is been translated in each of the language approximately and the word is considered as an essential term for an industry.

II. Mechatronics in MEMs

Micro Electro-mechanical system or MEMs refer to the miniature mechatronic systems. These systems are being fabricated by VLSI (very large scale integration) technology. The Arthrobot was first robot to assist in surgery developed and used for first time in Vancouver in 1983. Dr. James McEween, Geof Auchinleck, biomedical engineer, a UBC engineering physics grad and Dr. Brian Day are deeply associated. On 12 March 1984, the robot was used for orthopaedic surgical procedure. Other related robotics device developed further on at the time which includes a surgical scrub nurse robot, which handed operative instruments on voice commands and a medical laboratory robotic arm. The robot Unimation Puma 200 was used to place needle for a brain biopsy using CT guidance in 1985. PROBOT was then used to carry out prostatic surgery and ROBODOC to aid with hip replacement surgeries. Later on the first surgical robot was approved by FDA. In 1992 the ROBODOC was introduced to mill out precise fitting for the hip replacements. MEMS have better quality with a low cost of production due to mass production are the advantages of mechatronics in MEMS. MEMs Robotic Systems i.e, Gyrover, Surgical robotic systems, Tele-manipulator and computerised method of surgery. Comparison with Traditional Method: Remote surgery, minimally invasive surgery and unmanned surgery are vital advances aided by surgical robots. Due to robotic in surgery, the surgery is done with accuracy, miniaturization, smaller incisions; decrease blood loss, slighter pain and quicker healing time. In an open technique surgery has many faults like limited access to surgical area, long recovery time, lengthy hours of operation, surgical scars and marks. Material Removal Processes: Etching: Etching done by goldsmiths and other metal workers in order to custom metal items such as military armours, cups and plates has been implemented in Europe since the middle ages at least. Daniel Hopfer (circa 1470-1536) of Augusburg, Germany is believed to invent the process as applied to printmaking. It's a traditional process of using strong acid to cut the affected parts of a metal surface to create a design in metal. In modern industrialisation and manufacturing process chemical are used for etching. It is an important technique in modern technology in a number of variant like photochemical and micro-fabrication etching. Etch species in plasma source can either be charged ions or neutral atoms or neutral radicals. [1] Kota et al. had proposed a generalized methodology of design compliant mechanisms with a practical layouts, size, and shape for MEMS and smart composition application. [2] Imamura et al. have suggested a new MEMS-based integrated head/actuator/slider concept for hard disk

drives. [3] Favrat et al. have reported on an integrated circuit to drive an electrostatic micro motor with a 1.5 V battery, the circuit is application specific and can output up to 80 V. The circuit was proposed for wearable systems. [4] Itoh adopted a fuzzy control method based on an image processing method to control the motion of the protozoa for bio-MEMS. [5] Dario and Fukuda have reported on a tele-operated mobile micro robot activated by an electromagnetic wobble micro-motor. [6] Yasodharan. R, Sivabalakrishnan. R & Priya. K explains about the innovative solutions for exploiting mechatronics in the medical instruments by optimizing conventional tools. [7] Luo and Pan reported on an intelligent mold with embedded MEMS-based micro sensors.

III. Mechatronics: Automation and Control Systems:

During 285-222 BC the Greek engineer Ctesibius invented a water clock by feedback control mechanism. The thermostat invented by the Dutch scientist Cornelius Drebbel in 1620s which are temperature controllers rather than on-off mechanism in household appliances commonly. In 1745 first automated loom was invented by Jacques de Vaucanson. In 1771 first automated spinning mill was driven by water power and known as water frame during that time is invented by Richard Arkwright. Further on, in 1785 automated flour mill was developed by Oliver Evans thereby making it first fully automatic or automated industrial process. Christian Huygens invented the centrifugal governor in 17^{th} century. Instrument and control system undergo a raid growth and operation in central electric power stations. In 1930s, controllers which are able to calculate the change in response to deviation from set of point rather than on-off control is introduced. Controllers continue to show gain in productivity, declining the influence of electrification problem in factory. Automation can be defined as the technology which is performed without human assistance. The term automation came from the earlier word called automatic. [8] Platt et al. have employed piezoelectric transduction for energy harvesting at low frequencies. [9] Park et al. have reported on the design and control of a sensorized micro-gripper, finite-element analysis is applied to improve the gripping sensitivity and optimize the gripper topology. [10] Perez et al. have reported on the modelling and fabrication performance characterization of a 2-DOF micromanipulation system articulated with piezo actuators. A model is proposed to minimize the hysteresis of the piezo actuators. Constant voltage control and constant charge control are implemented simultaneously to reduce the hysteresis by one order of magnitude. This is demonstrated experimentally. [11] Ferreira et al. reported on a micromanipulation system for visually served tele-operated micro assembly. A vision base position control and force control are implemented for a pushing-based micromanipulation strategy. A typical micro assembly scenario is implemented using millimetre-sized components.

IV. Mechatronics in field of Automobile:

The history of automobile can be differentiated into number eras and prevalent propulsion. Later on automobile defined by trending exterior, styling, size and utility preferences. In 1870 the first gasoline powered combustion engine was built by Siegfried Marcus. Nikolaus Otto invented the four-stroke petrol internal combustion engine. Similarly Rudlf Diesel patented four-stroke diesel engine. In 1838, Christian Friedrich Schonbein discovered hydrogen fuel as a replacement of gasoline as an energy source to the cars. Electrically powered automobiles became popular at the early 20th century, but it didn't last long of automobile propulsion and till 21st century the automobiles diminished to a niche market. Application of mechatronics in automobiles are Car engine management systems, the engine speed sensor system, temperature sensor system, wheel speed sensors and Steering angle sensors and Air-bag inflation. [12] Tanujap. Mote, Meenal. R. Majge & Gouri. P. Bramhakar presented about the mechatronic system and its element in an advance vehicle control system**.** [13] Hans-Peter Schöner represented on the automotive innovations, development and mechatronics. [14] Ebinezaru Babu Gollamudi,Venkata Ramesh Mamilla, Tippa Bhima Sankara Rao gave a study on the development and design of a mechatronic system**.** [15] Mr. Muhammad Danish, Md. Akhlak Ahmed presented a paper on "Study of Car Mechatronics".

V. Mechatronics: Advanced Manufacturing and Production Process

It is defined as process of producing goods or merchandise for use or sells using labour, machines and tools. The raw materials are converted to finished goods or merchants in a large scale in processing or formulation in an industrial production. The process of manufacturing begins from the product design and material specification from which the product is made up of. These products further on modified on the basis of the required part by the manufacturer. Application of manufacturing and production process consists of Tool monitoring systems and computer Numerical Control machines (CNC). Advantages of Mechatronics in Manufacturing System are effective product quality, better control system, automated production, minimal time and labour required and high production rates. [16] Tamas Becsi, Szilard Aradi and Peter Gaspar had presented an experimental vehicle framework mechatronics. [17] Devdas Shetty, LouManzione and Ahad Ali represented the paper examines the application of integrated tools for setting up a virtual prototype at early phases of the development process. [18] P. N. Rao, FMS combines microelectronics and mechanical engineering to bring the economies of the scale to batch work. [19] Jadi Laxman and Kotakonda Guru Raj presented about the "electric discharge machining process". [20] Reynaerts et al. presented a mechatronic design of micro systems.

VI. Conclusion

It's quite interesting to see that how advancement of mechatronics implemented in mechanical area which leads to a new and effective aspect to perform. Mechatronics put together number of technologies i.e, mechanical engineering, information technology and control engineering techniques through electronic and electric interfaces to solve mechanical problems. Hence, mechatronics is a vast term which can be enhanced and researched more to get new innovations to meet the problems in field of mechanical engineering.

References

[1] S. Kota, J. Hetrick, Z. Li, and L. Saggere, "Tailoring unconventional actuators using compliant transmissions: Design methods and applications," IEEE/ASME Trans. Mechatronics, vol. 4, no. 4, pp. 396–408, Dec. 1999.

[2] T. Imamura, M. Katayama, Y. Ikegawa, T. Ohwe, R. Koishi, and T.Koshikawa, "MEMS-based integrated head/actuator/slider for hard disk drives," IEEE/ASME Trans. Mechatronics, vol. 3, no. 3, pp. 166–174, Sep.1998.

[3] P. Favrat, L. Paratte, H. Ballan, M. J. Declercq, and N. F. deRooij, "A 1.5-V-supplied CMOS ASIC for the actuation of an electrostatic micro motor," IEEE/ASME Trans. Mechatronics, vol. 2, no. 3, pp. 153–160, Sep. 1997.

[4] A. Itoh, "Motion controls of protozoa for bio MEMS"IEEE/ASME Trans. Mechatronics, vol. 5, no. 2, pp. 181–188, Jun. 2000.

[5] P. Dario and T. Fukuda, "Focused section on micro mechatronics—Guest editorial," IEEE/ASME Trans. Mechatronics, vol. 3, no. 1, pp. 1–2, Mar. 1998.

[6] Yasodharan. R 1, Sivabalakrishnan. R2, Priya. K3, International Journal of Pharmaceutical Sciences and Business Management, Vol.2 Issue. 11, November- 2014, pg. 52-59 ISSN: 2310-6913

[7] R. C. Luo and Y. L. Pan, "Rapid manufacturing of intelligent mold with embedded micro sensors," IEEE/ASME Trans. Mechatronics, vol. 12, no. 2, pp. 190–197, Apr. 2007.

[8] S. R. Platt, S. Farritor, and H. Haider, "On low-frequency electric power generation with PZT ceramics," IEEE/ASME Trans. Mechatronics, vol. 10, no. 2, pp. 240–252, Apr. 2005.

[9] J. Park, S. Kim, D. H. Kim, B. Kim, S. J. Kwon, J. O. Park, andK. I. Lee, "Identification and control of a sensorized microgripper for micromanipulation," IEEE/ASME Trans. Mechatronics, vol. 10, no. 5, pp. 601–606, Oct. 2005.

[10] R. Perez, J. Agnus, C. Clevy, A. Hubert, and N. Chaillet, "Modeling, fabrication, and validation of a high-performance 2-DoF piezoactuator for

micromanipulation," IEEE/ASME Trans. Mechatronics, vol. 10, no. 2, pp. 161–171, Apr. 2005.

[11] A. Ferreira, J. Agnus, N. Chaillet, and J. M. Breguet, "Smart microrobot on chip: Design, identification, and control," IEEE/ASME Trans. Mechatronics, vol. 9, no. 3, pp. 508–519, Sep. 2004.

[12] Tanujap. Mote, Meenal. R. Majge & Gouri. P. Bramhakar International Journal of Electrical and Electronics Engineering (IJEEE) ISSN(P): 2278-9944; ISSN(E): 2278-9952 Vol. 5, Issue 5, Aug – Sep 2016, 13-24.

[13] Hans-Peter Schöner Daimler Chrysler Research and Technology Head of "Actuators and Mechatronics". (This paper is an extended version of a presentation at the IFAC Conf. on Mechatronic Systems, Dec. 2002).

[14] Ebinezaru Babu Gollamudi,Venkata Ramesh Mamilla, Tippa Bhima Sankara Rao"Introduction to the development and design of a mechatronic system", 2248-9622, Vol. 1, Issue 3, pp. 542-545.

[15] Mr. Muhammad Danish, Md. Akhlak Ahmed "Study Of Car Mechatronics""A Research And Review Paper Under The Concept of Mechatronics".

[16] Tamas Becsi, Szilard Aradi and Peter Gaspar, "Educational Framework for Vehicle Mechatronics" IEEE/ ASME Transp. system society, vol. 16, no. , pp. - ,Dec. 2015.

[17] Devdas Shetty, LouManzione and Ahad Ali Journal of Robotics Volume 2012, Article ID 932305, 9 pages doi:10.1155/2012/932305

[18] P. N. Rao. CAD/CAM Principles and Applications, Tata McGraw Hill, 2011.

[19] Jadi Laxman and Kotakonda Guru Raj International Journal of Advanced Mechanical Engineering. ISSN 2250-3234 Volume 4, Number 7 (2014), pp. 729-739

[20] D. Reynaerts, J. Peirs, and H. Van Brussel, "A mechatronic approach to micro system design," IEEE/ASME Trans. Mechatronics, vol. 3, no. 1, pp. 24–33, Mar. 1998.