

A Review on Applications of Cyber Physical Systems

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Abstract

Cyber Physical Systems(CPS) are a new research paradigm in embedded systems. Cyber Physical systems are collaboration of physical and computational process. Different types of technologies such as sensing, communication, computation, control, cognition are used to create new technology. Cyber Physical Systems are intersection of different technologies such as real time systems, Distributed systems, control systems and wireless sensor networks. Cyber physical systems have diversified applications include smart grid, autonomous automotive systems, medical monitoring, process control systems, distributed robotics, and automatic pilot avionics [1]. This paper presents a survey on different types of applications of cyber physical systems

Keywords: Cyber Physical Systems, Embedded systems, Control systems, smart grid, Traffic System Control, Humanoid robots

1. Introduction

Cyber-Physical Systems (CPS) is integrations of computation, networking, and physical processes. Embedded computers and networks monitor and control the physical processes, with feedback loops where physical processes affect computations and vice versa [2]. The technology builds on the older (but still very young) discipline of embedded systems, computers and software embedded in devices whose principle mission is not computation, such as cars, toys, medical devices, and scientific instruments [2]. Due to cyber physical systems huge systems existing in the physical world can exchange data, interact with each other, access web services in the future. By merging computing and communication with physical processes and mediating the way we interact with the physical world, Cyber-Physical Systems has many advantages (i) they make systems more efficient and safer. They reduce the cost of building and operating these systems; and they allow individual machines to work together to form complex systems that provide new capabilities [6].

This paper presents a review of applications of Cyber Physical Systems in different domains. Section 2 discusses the advantages of Cyber

Physical Systems. Section 3 gives a brief description of applications of Cyber Physical Systems in different domains. Finally this paper is concluded with section 4.

2. Advantages of Cyber Physical Systems

Integration: The integration of cloud and Wireless Sensor Networks is also an important part of Cyber Physical Systems. CPS provides network integration characteristics such as media access control techniques and their effects on system dynamics, middleware, and software that provide coordination over networks control over timing of network transactions, and fault tolerances [7].

Interaction between Human and System: Modeling and measuring situational awareness-human perception of the system and its environmental changes in parameters are critical for decision making.

Dealing with uncertainty: certainty is the process of providing proof that a design is valid and trust worthy. Cyber physical systems can be able to evolve and operate with new and unreliable environment.

Major headings are to be column centered in a bold font without underline. They need be numbered. "2. Headings and Footnotes" at the top of this paragraph is a major heading.

Better System Performance: CPS is able to provide better performance in terms of feedback and automatic re-design with close interaction of sensors and cyber infrastructure.

Scalability: As a part of cloud computing CPS is able to provide the resources to users according to their requirements.

Flexibility: CPS can provide more facilities than WSN and Cloud Computing alone

Faster response time: CPS will increase the fast response time and facilitate the early detection of failure, proper utilization of resources such as bandwidth.

3. Applications of Cyber Physical Systems

Green Buildings: Greenhouse effect is one of the major problems in today's world. The old buildings consume 70% of the electricity produced and generate the greenhouse gases which in turn increase greenhouse effect. By using the integrated Wireless Sensor Network, cognition manager and control systems we can achieve Zero Net Energy goal.

Smart grid: Smart grid is an ecosystem which will rely on its basis on information acquisition assessment and decision making as well as management. In smart grid many traditional parts use Cyber Physical Systems. They are used in generation, transmission and distribution and also in customer side. In generation it will control the connection of the network as well as the operational aspects in the electricity generation. CPS monitor the conditions and care for the stability of transmission and distribution networks that connect end-users to smart grid[8]. It will provide two-way communication and control between power grid and consumers.

Medical CPS: Wireless Sensor networks collect the diagnostic information, monitor the health and drug administration of patient's. The integration of computing and control mechanisms to the critical medical information communicated provides a fundamental prerequisite to high-confidence medical cyber-physical systems[11].

Intelligent Transportation systems: Cyber Physical Systems provide a way to improve traffic system control performance. Road Traffic-control Cyber Physical System constructs an environment that exists in the natural geographical environment and manmade environment such as bridges across the sea or rivers, long and big tunnels, high-risk sub-grade slope, urban elevated bridges, etc but, but also massive variety of vehicles, people and goods in the complex road environment. Intelligent Transportation System, can realize the traffic control by adding and installing a large amount of advanced electronic devices and information systems to the road traffic system, improving operational efficiency and safety level for the road traffic system. Traffic control Cyber Physical Systems integrate these information into the transportation process, and operate through their coordination making the transportation more safe and efficient[9].

Humanoid robots: Humanoid robots can be used for (i) taking care of the elderly people at home (ii) scientific investigation of undersea environments, rain forest environments, space environments and critical infrastructure protection (iii) can be used for personnel purpose (iv) can be used in agricultural fields. (v) rescue

operations in the event of emergencies and dangerous work environments.

Smart learning environments: Cyber Physical Systems can be used in Smart learning environment. CPSs can be used in the SLE to gather adequate information about the physical environments, convert measured data to information and knowledge, and eventually provide useful and prompt services for students, staffs and the university. Smart learning environment (SLE) will definitely transform the way people learn and work in universities [10].

Civil infrastructure Monitoring: Today lot of civil engineers face the problem of stewardship of ageing of infrastructure like dams, bridges, buildings etc. Fiber optic sensors and Micro electrical and mechanical sensors and wireless communication technologies offer tremendous promise for accurate and continuous infrastructural monitoring[11].

Aeronautic applications: Cyber-Physical Systems are used for Aeronautic applications such as flight test instrumentation, Pilot-crew communications, Structure Health Monitoring, In-flight tests, in flight entertainment Wireless Cabin, and flight landing etc.

4. Conclusions

This paper discussed the applications of Cyber physical systems in different domains briefly. CPS provides better solutions to some of the real time problems facing in today's world. Cyber Physical Systems change the way how humans interact with the physical world. In future we discuss the application of Cyber Physical System in each domain elaborately.

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