

Fault Detection and Fault Tolerant System for Smart Factories

Prajakta Jadhav^{ab}, In-Geol Chun^{ab}

^a UST(University of Science and Technology), Daejeon, Korea

^b ETRI(Electronics and Telecommunications Research Institute), Daejeon, Korea

prajakta65@etri.re.kr, igchun@etri.re.kr

Abstract—Cyber-Physical Systems (CPSs) is an emerging technology which unites the cyber world of computing and communication with physical world. CPSs increases efficiency and reliability of system to work in real-time environment. Cyber-physical systems are important part of the fourth industrial revolution named as ‘Industrie 4.0’. The use of CPSs with production systems gives rise to the ‘smart factories’. Smart factories are fully automated cyber-physical production systems which will automatically manage the industrial processes. Smart factories are adopting fully automated environment for reliable and efficient operations. Therefore requirement of smart industrial systems is increasing day by day. The physical environment in which the industrial systems operate is uncertain as well as unpredictable. On the other hand, the cyber world of computing and communication is not flexible. Therefore, failures can occur in industrial systems, which decrease the productivity of the system. Hence, it is necessary to detect faults in the system to avoid further losses. Designing a reliable, intelligent and efficient system can help to overcome the drawbacks of physical systems.

In this paper, we have proposed a fault detection and fault tolerant system for smart factories. By using fault detection and tolerance method we can deal with uncertain and unpredictable nature of industrial systems. For experimental purpose a pick and place robot is designed using unified modeling language and LEGO Mindstorms NXT kit. A fault analysis model is developed to organize all the possible faults in robotic system. Residual generation method is used to detect the faults. Some faults exists in sensors and actuators of robot which are unsynchronized. But the system should operate continuously hence a fault tolerance method is required. Fault tolerance method using neural network’s feed forward and backpropagation techniques is used. It is a self-adaptive data driven technique with high degree of accuracy. We have trained the faulty data using neural network methodology to remove the faults occurring in pick and place. From the results, we can conclude that the proposed system can detect the faults as well as it has capability to reduce those faults up to great extent of robotic system.

Keyword—Cyber-physical systems, fault detection, fault tolerance, neural networks.



Prajakta Jadhav is currently Master’s student in University of Science and Technology (UST), Daejeon South Korea. She received bachelor’s degree in E&TC in 2011 from University of Pune, India. She is a student researcher in Cyber-Physical Systems Research Lab in Embedded SW Research Division of Electronics and Telecommunications Research Institute (ETRI), South Korea.



In-Geol Chun received his Ph.D. and M.S. degrees in Electrical and Computer Engineering from SungKyunKwan University, Korea, in 2010 and 1997 respectively. He is currently the director of CPS research section in Electronics and Telecommunications Research Institute (ETRI) from 1998 and also an adjunct professor in University of Science and Technology (UST) from 2012. His research interest are Cyber-Physical Systems (CPS), Smart Factory, Autonomic Computing Systems, Embedded Systems and Software Engineering.