Remote Control and Monitoring of AX-12 Robotic Arm Based on Windows Communication Foundation

Michał A. Mikulski and Tadeusz Szkodny

Abstract. The paper proposes a service-oriented architecture system for control and state monitoring of robotic manipulators. Experiments were performed with the use of 4 degree-of-freedom AX-12 Robotic Arm manipulator with gripper and laser effector, as well as a high resolution GoPro Hero HD camera and frame grabber. Multimedia device management and video capture has been done via DirectShow.NET libraries. The infrastructure is based on Windows Communication Foundation (WCF) for remote access, authorization, multimedia streaming and servo control. Client manual control has been implemented with the use of 3 degree-of-freedom DirectX compatible Joystick. The paper summarizes development experiences and problems concerning the use of WCF in robotics.

Keywords: robot control, AX-12 Robotic Arm, Windows Communication Foundation (WCF), Service-oriented architecture (SoA).

1 Introduction

With the rapid growth of Cloud Computing and web-oriented applications, Internet-based control and information exchange is becoming more and more popular [13, 12]. In the modern age, environments such as the medical sector are reaching towards Internet oriented distributed systems. RIS (Radiology information system), PACS (Picture archiving and communication system) and many other medical information systems are using the Internet as means of data transfer. With the growth of robotics and their integration in Service-oriented architectures (SoA), medical manipulators can perform tasks with the surgeon miles away. In this paper we

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present a robotic work station, controlled manually with a Joystick over the Internet, using Windows Communication Foundation (WCF). The paper evaluates the use of WCF for controlling manipulators as well as other types of robots. The article is divided into sections: Section 2 describes the AX-12 Robotic Arm, as well as it's controller and Joystick teleoperation, Sect. 3 describes the vision system used for video recording and streaming, Sect. 4 describes the details of WCF usage and SoA control of the manipulator. Finally, Sect. 5 summarizes the results of the research.

2 AX-12 Robotic Arm

AX-12 Robotic Arm is a 4 degree-of-freedom serial manipulator with 7 AX-12+ Dynamixel servomechanisms constructed by CrustCrawler Inc. It consists of 4 revolute joints named by the community as: base, shoulder, elbow and wrist, as well as a gripper end effector, presented in Fig. 1.

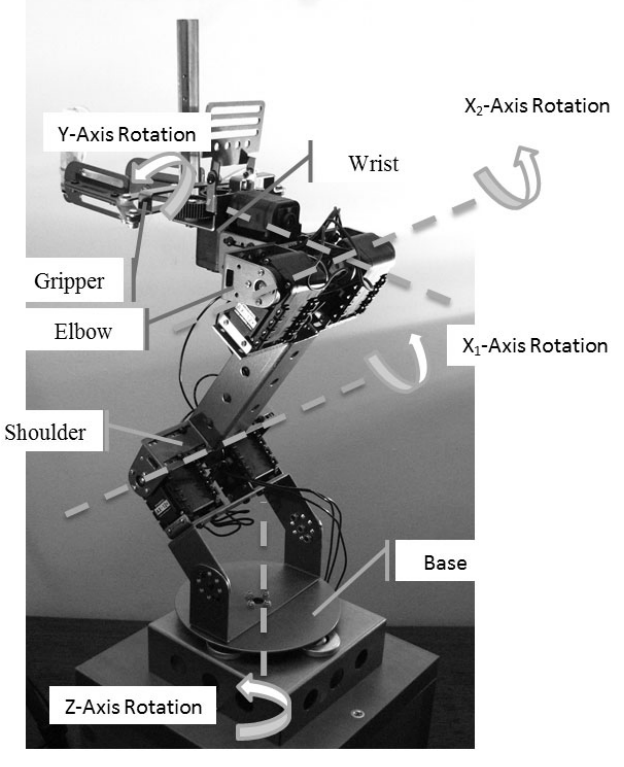

Fig. 1 AX-12 Robotic Arm revolute axes