Synchronized Communication used in Collaborative Humanoid Robots with Datacenter Applications

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Abstract. This manuscript is to describe a communication method used to operate data center related applications where multiple robots are required. In this configuration one of the robots is considered as the leader while the other one performs as a follower. The operations performed from the collective operation of the two robots aim to reach a coherence to allow applications that require multiple robots to be performed seamlessly. The development of this work was based on humanoid robots though it can be expanded to any robot platform based on a given application.

Keywords: Synchronized Robots, Robot Communication, Arbotix-M, XBee.

1 Introduction

Designing a datacenter with "human operator" brings various limitations. These limitations include environmental conditions such as temperature limits, power limits such as low voltages, safe materials, human approachable dimensions and human carriable weights. Without factoring human as the operator most of these limitations can be lifted, resulting in a more efficient design. Besides, computers can take advantage of lower temperature environment allowing them to operate at higher frequencies and more heat dissipation.

Using robots instead of human in datacenter can be rewarding due to the fact that robots can operate in a wide environmental condition in comparison to humans. Robots can carry heavy weights and can be designed to operate in any dimension without the human physiology limitation.

Changing the current design of datacenters from a human centric to a robot centric model requires years of development and experimentations. Considering humanoid robots as the most human like robots, the gap between human dexterities and capabilities versus a robotic analogue can be minimized.

Most of the current datacenter tasks can benefit from a collaborative operation of multiple robots. The robots operating in a collaborative task require to be synchronized in order to perform a given tasks coherently.

2 Method

In this work, two humanoid robots from Robotis (Bioloid) have been used to demonstrate the capabilities of humanoid based synchronized collaborative operation. One of the robots performs as the lead while the other one is the follow. The leader robot generates the required motions for itself as well as the follower robot. In order to achieve the described scheme, both robots' main controller has been redesigned based on the open-source Arduino based Arbotix-M controller shown in figure 1, preserving the AX-12A servo motors and the humanoid mechanism from the Robotis Bioloid robot shown in figure 2.

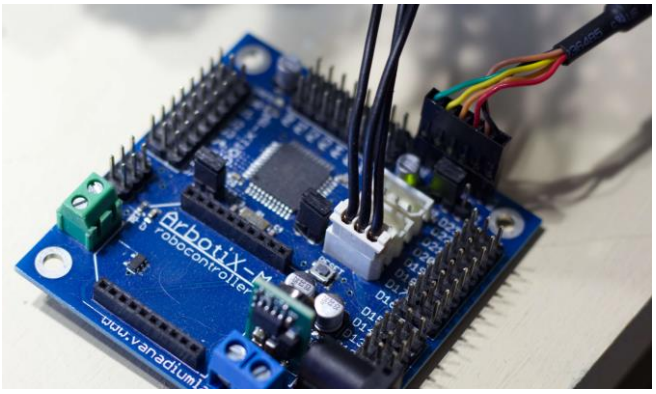

Fig. 1. Arbotix-M opensource robot controller [1]

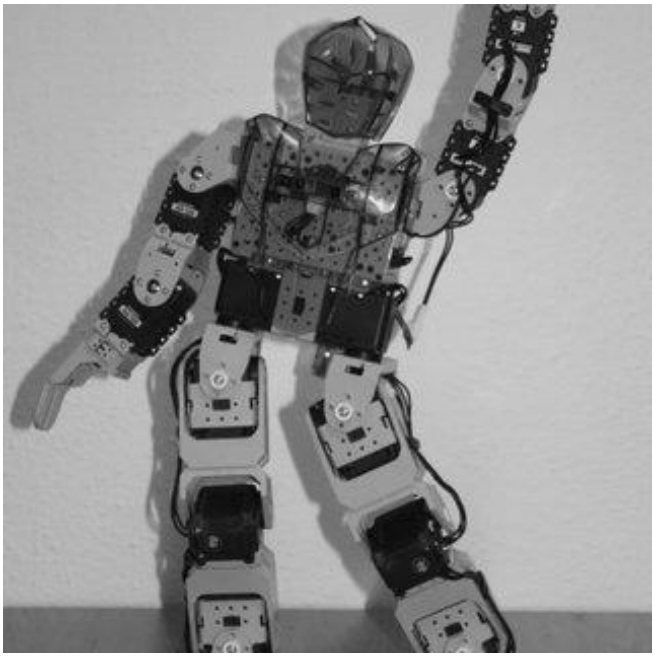

Fig. 2. Bioloid humanoid robot [2]

The communication between the two robots is performed using a pair of XBee 1mW modules shown in figure 3. The two modules use a 802.15.4 stack to establish a simple serial communication with a 250kbps max datarate, sufficinet for this application. The communication package includes the position angles of each servo motor for the follower robot followed by a CRC-checksum. Upon receiving the data package the follower robot calculates the checksum and compares it with received checksum to assure the accuracy of the incoming data.

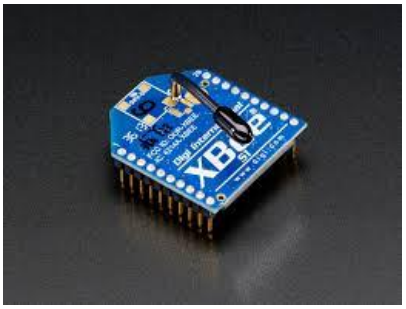

Fig. 3. XBee module [3]

Upon checking the accuracy of the incoming data, the controller will execute the position angles. Once the position angles are executed successfully the follower controller will send an acknowledgement signal to the leaders controller ensuing to the next time stamp.

3 Experiments

The two robots are trying to walk a straight path, holding a stick from the two ends (each robot holds one end). In order to perform this task successfully, both robots need to perform synchronized, temporally and specially.

4 Results

The experiment was performed successfully as both robots operated synchronized and the task was achieved.

5 Conclusion

Performing synchronized collaborative tasks using multiple robots has the potential to be used as an alternative for human centric applications. The tests are executed, utilizing simple humanoid robots regarding the cost orientation of the project after the main focus should be the communication issue. With robots of any kind and not only human-like ones with heavy-duty power elements, various tasks in a data center are potentially achievable.

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