Low Cost Telepresence Robot

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Telepresence robotics is an application in robotics which allows you to mark your presence in a location where you are not physically present. It not only allows you to present yourself, but also perform rudimentary activities (such as movement), on your behalf. Unfortunately, the use of telepresence robots is greatly limited due to the high cost of commercially available robots. This limitation is overcome in this project by producing telepresence robots which are appropriate for institutional or household use, at a lower cost.

Existing commercial telepresence robots use dedicated and specialised hardware components for their key activities. Although desirable, the major drawback of using these hardware components is their high cost and therefore, the unaffordable price of the robot. As a low cost alternative, use of special hardware components is avoided wherever possible and attempts are made to obtain the same functionalities through the use of general purpose hardware (such as a laptop motherboard) and software.

The structure of the robot consists of a power circuit, a motor circuit and a laptop. The laptop controls the movements of the robot through USB or parallel port interfacing and in addition the peripherals at the laptop such as Wireless Local Area Network (WLAN) card, microphone, speakers, webcam and display are used for the controls and activities of the robot. A remote user can interact with the robot via a Wi-Fi network connection maintaining video and audio streaming conversation to interact with the remote environment. In addition to the manual control, an automatic mode of operation uses image processing for controlling the robot.

Avoiding specialised hardware in this project adds a new challenge. That is, the way of implementing efficient and reliable functionalities on the software which were successfully implemented on hardware in the existing telepresence robots. In our software implementation, there are two main software programs, one for the controller of the robot and the other for the robot. Both software programs are implemented using Java and Java Media Framework (JMF) is used for handling audio and video streaming over Real-time Transfer Protocol (RTP). The software program at the robot differs from the other, since it includes computer interfacing to handle the motor-controlling circuit according to the signals sent by the controller over the WLAN network.

Our approach to the software implementation showed constant 2s to 4s RTP streaming delay but did not show any processing failure even with a low-performance processor (Intel Pentium III 1 GHz) in the robot. Reducing video resolution before transmission and increasing it after receiving did not help to improve the performance since the conversion process using JMF took a considerable amount of processing. Since the robot's computer had a limited amount of physical memory, it did not show general performance gain of a multithreaded program. In addition, this implementation requires at least an IEEE 802.11g type WLAN.

This project allows implementing a telepresence robot with basic functionalities for the cost of around LKR 25000 (around USD 250; a commercial telepresence robot costs in the order of a few thousand USDs). Manufacturing cost is reduced by reducing the involvement of the hardware as much as possible. On the other hand, the overall functions are greatly limited with the processing power and the battery life of the laptop. However, the software of the robot system is highly extensible such as intergrading image processing techniques for sensing the environment.