Snapshot Report

Remote Operations - Shadow Robots

Remote Operations - Shadow Robots - Stage 1

Project Code
2021-1224

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Date Submitted
30/06/2022

Project Description

This project will provide a concept design of remote-controlled shadow robots in the meat processing industry, in which the robotic arms can be controlled remotely and duplicate human motions in real-time. The project aims to eliminate direct human involvement in high-risk operations and retain human workforces under safer and better working conditions. At this stage, the project has successfully developed a conceptual shadow robot system, in which the operator wears a 3D printed exoskeleton device with potentiometers attached to measure her/his joint angles and drives two UR5 robotic arms to achieve the human poses. To demonstrate the system's capability and functionality, the testing operator drives the robotic arms to pick up an object, hand it over to the other arm and drop it off at a desired reachable position. This proof of concept development demonstrated that the designed shadow robot system could be used to duplicate human motions. This report introduces the system design of the shadow robot and the methods of detecting human poses and transforming them into robot motions. The report also discusses some issues that need further investigation, which will potentially improve the system's performance and functionality.

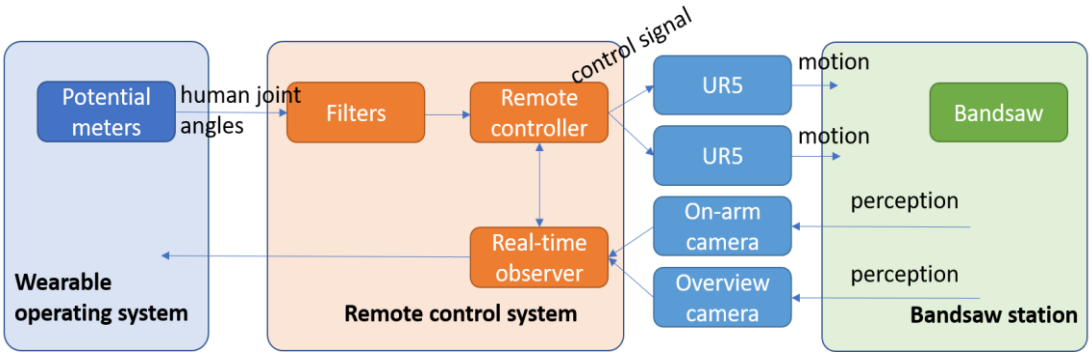

Figure 1 The shadow robot system structure

Project Content

Figure 1 shows the system structure of this remote-operating shadow robot. There are two main sub-systems which are the wearable operating system and the remote-control system. The operating system includes sensors and potentiometers, which will be attached to an operating suite and worn by the human operator, and human motion data are outputted to the remote-control system, which analyses the input data and converts them into control signal which drives the physical platforms (UR5 robotic arms) to work on a bandsaw station. An overview camera is set on top of the bandsaw station, and on-arm cameras are attached to the robotic arms. Visual images are fed to a real-time observer, which allows the human operator to monitor the situations.

Project Outcome

We have developed and tested the shadow robot system in a virtual simulation environment and with the physical robotic arms to test their feasibilities. With the virtual simulation, we tested the vision-based motion detection and potentiometer-based sensing, and we concluded that the vision-based approach is not suitable for this project due to its limitation in detecting three-dimensional poses. We processed to test the wearable exoskeleton with the physical robotic arm platforms. Figure 2 shows the physical testing setup.

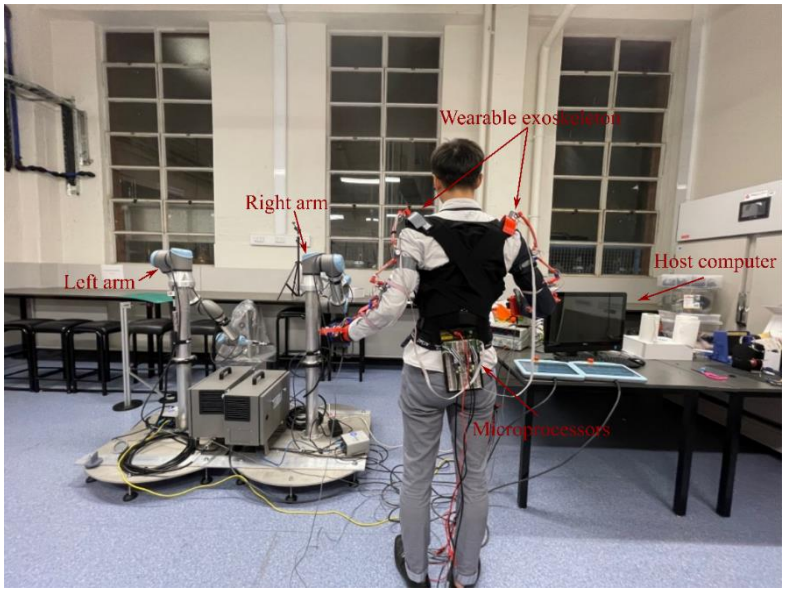

Figure 2 Physical test setup

Benefit for Industry

The project aims to eliminate direct human involvement in high-risk operations and retain human workforces under safer and better working conditions. Based on the project discovery and development, we found that the designed shadow robot can be used in multiple meat processing scenarios to replace humans in high-risk operations. We also suggested some key aspects that need to be further investigated.

Useful resources

Link to the BOX folder with testing videos:
https://universityofadelaide.box.com/s/65p5lfdr795rjkgix16680zhlnsxkv5e
Password: AMPCUoA2022

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