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Improving Human-Robot Collaboration Efficiency with Stereo Camera and Gesture Recognition

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***Abstract*—The aim of this research paper is to solve the efficiency issues when human and robot work in a shared workspace. The proposed system is utilized using a stereo camera for body tracking and a wearable bracelet for detecting human motion and gesture recognition. The collected data sets from the camera and bracelet are used for training deep learning models to identify body and hand behaviors. The system was also integrated with the robot operating system (ROS) to control the robot arm for assisting human operations. The results demonstrate the feasibility and effectiveness of the proposed approach in identifying human behaviors in real-time. The approach can improve the performance of human and robot collaboration.**

I. Introduction

In this study we propose a collaboration system that aims to enhance the efficiency of human-robot collaboration in a shared workspace. In this system, a camera is used to identify body movements, and a bracelet is used to detect hand movements. The proposed approach is expected to improve the performance and safety of human-robot collaboration in various industrial and manufacturing settings.

II. Methods and Results

Human-robot collaboration system was developed to enhance cooperation between humans and machines. The system used three main components the *ZED2 Camera*, *CoolSo bracelet*, and the *robot operating system* (ROS), as shown in Figure 1. The *ZED2 camera* focuses on a person's bones detection and tracking. A detected bone is represented by its two endpoints also called key points. The *ZED2 camera* can provide 2D and 3D information on each detected key points. The data of the detected skeleton is later processed to recognize body actions by using a deep learning model. The *CoolSo bracelet* played a crucial role in gesture recognition due to hard detection to small motions just using *ZED2* when human assembles the precise connector product shown in Figure 2. The collected gesture signals using MMG (muscle movement) in the bracelet is next used to identify hand actions with the help of AI developed from *ResNet*. Both of body and hand actions are used to describe human actions. Therefore, the detected human actions are able to improve human-robot collaboration.

To test how well the system worked, a scenario was created where a robot and a human worked together to assemble electronic connectors, as shown in Figure 3. The environment is constructed by using robot operating system (ROS) and a robotic arm *UR5*. The system combined the information from the *ZED2* camera and the *CoolSo bracelet* to understand what was happening. Based on this information, the robot made smart decisions and stepped in when needed to help the human to finish the task as the results.

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Future Works

Optimization of the system performance will be the next stage of this research. Also, to create an easy-to-use interface that allows people to control a robotic arm using natural language. We want to use ChatGPT and robot operating system (ROS) to achieve this goal.

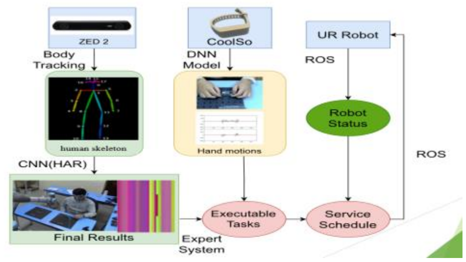

Figure 1. *Proposed human-robot collaboration system*

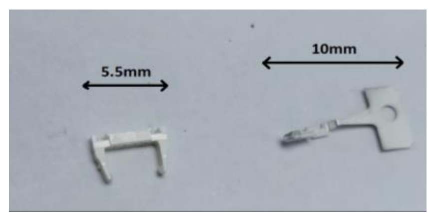

Figure 2. *The dimensions of the connector product*

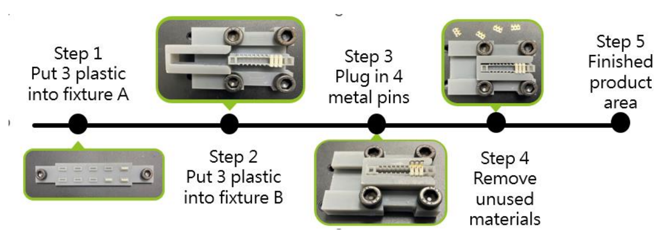

Figure 3. *Proposed human-robot collaboration scenario*

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