Expanding Robotic Interaction and Maneuverability Through Holonomic Motion In Remote Robotic Intervention

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Abstract
Robots have become fairly popular when it comes to designing and testing new technologies, and are also prevalent for remote intervention tasks. Sending robots to Mars to explore the surface, or having a bomb squad extract a bomb are some examples of remote robotic intervention tasks.

Method
This section will cover the following:
- CAN Communications
- Chassis
- Holonomic Wheels

CAN Communications
For our robot, we are using a kit provided by AndyMark. In this kit, we have a Pocket N-Router, 2CAN devices, and a Canipede RCM. These devices will allow for other components to easily be integrated into our robot such as sensors and anthropomorphic robotic arms.

Chassis
For this project, we are using the AndyMark C-Base Chassis Kit that is used in the FIRST Robotics Competitions. However, we designed the chassis in Solidworks before we began to fabricate it (as shown in Figure 5). Figure 6 shows the current robot after fabrication has been completed.

Method (Continued)
In order to move each wheel individually, the operator uses a program called CrossLink Robot Control System (provided by the CAN system product) that is also connected to a controller. In the program, the operator can assign buttons or motions on the controller in order to move the robot. Once that is done, the operator can connect to the router mounted on top of the robot via WiFi or Ethernet cable. The input signals that are given by the controllers and program get sent to the router, to the 2CAN, to the Canipede RCM, and then to the four speed controllers (Jaguars), which are each connected to a motor and wheel, thus turning the wheel in the direction the operator programmed. The onboard webcam sends live video footage back to the operator in order to see where the robot is facing and doing and the operator can make adjustments based on the footage. This process can be shown in Figure 12.

Future Research
Right now for the robot, we are working on setting up the WiFi communication so that we could use our school's WiFi and 4G hotspots to allow us to take the robot anywhere. The chassis of the robot will be redesigned and built using FRP material. Our group is also looking to integrate an anthropomorphic robotic arm, specifically the AX-18A robotic arm made by CrustCrawler Robotics, to allow our robot to interact with the environment. It will also have a webcam mounted to send feedback to the operator. (Figure 13)

Conclusion
By looking into holonomic motion, this allows robots to move in any direction which gives the operator full control where the robot is facing and how it turns at any given time. However, there are some disadvantages of holonomic wheels. The biggest problem is that there are smaller rollers mounted around the wheel, which makes the robot vulnerable to other forces that can cause the robot to move due to the little friction that is given by the wheels that are in contact with the ground. Holonomic wheels also cannot reach higher speeds due to the design of the wheels and the amount of friction generated from each roller at higher speeds. Despite these disadvantages, the advantages outweigh them. For example, a company called Airtrax uses mecanum wheels on their forklifts. The forklifts work in the same way as our robot, but instead they can transport bigger goods inside warehouses and not have to worry about reversing and hitting other objects and can transport these goods with ease. When used in intervention tasks, maneuverability is important because the robot is like an extension of a human being's arms and legs. By sending a robot instead of a human to perform a dangerous task, it reduces the risk of a human losing their life.

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