ABSTRACT OF EXHIBIT
TAIWAIN INTERNATIONAL SCIENCE FAIR

CATEGORY: Engineering
TITLE: $M^2$4WS^2 (Multiple Mode 4 Wheel Steering System)
NAME: Jonathon Platt
COUNTRY: New Zealand

The idea for my steering system started from a discussion with my Tech teacher about a wheel the Mechatronics and Robotics Research group of Massey University were working on. It featured precision shaped rollers at 45 degrees to the wheel's axle. The idea was that with a number of these wheels a vehicle could go in any direction, depending on the rate that each wheel was revolving.

After looking into some other methods of making a robot that would have the same driving experience, I came upon the idea of four wheels independently steered and driven with four servos and four motors. This instantly appealed to me because there was a lot of potential for expanding the project as the program controlling the servos and wheels could be made as simple or as complex as I wanted. An example of the complexity reached in the programming is the mixing of the throttle and steering controls to achieve an electronic differential, using physics calculations for wheel angles and revolutions per second to ensure the wheels were angled correctly and rotating at the correct rate in accordance to the controller's throttle and steering positions. To do this I had to use four separate micro-controllers to control a servo and motor each, with a master controller sending data to them.

The programming of the micro-controllers used for my project was the biggest challenge because I was experimenting with and using features which had not previously been used by the other students or teacher, such as the SPI and Interrupt function. The main challenge in the programming was setting up an effective communication network between the master and slaves that would fit into the precise timing of the pulses to the servos. Also the motors I was using to drive the wheels were electrically very noisy, and this resulted in a lot of modifications being required to suppress this noise and prevent it from contaminating data being sent from master to slave.

The bulk of the project was getting the program running but there were quite a few mechanical challenges in getting the power to the motors and being able to rotate the motors and wheels through 180 degrees. This was made difficult because of the forces the axle had to withstand when suddenly changing direction and also ensuring the motor wires didn't catch anything. The solution came by turning free-machining aluminium rod for the axle turning the motor and wheel, and routing the wires up through a hole in the rod.

The finished project’s strength comes from its ability to navigate through and around objects in extremely tight spaces, giving the driver unlimited control. For the purposes of my tech project the system is radio controlled but it also has the ability to be fully automated through the use of sensors and a navigation program. Uses for this system are quite extent, and can range from transporting materials in warehouses to controlling props on a theatre stage.