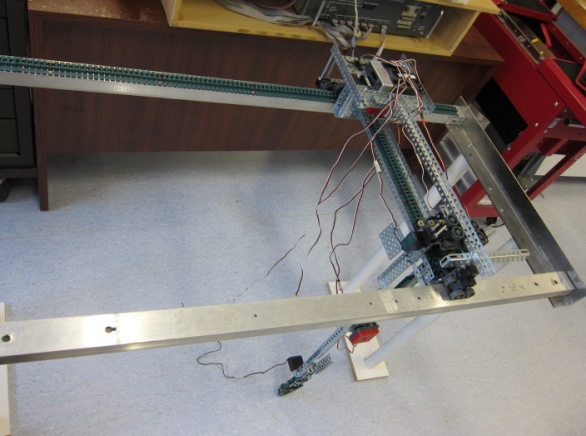
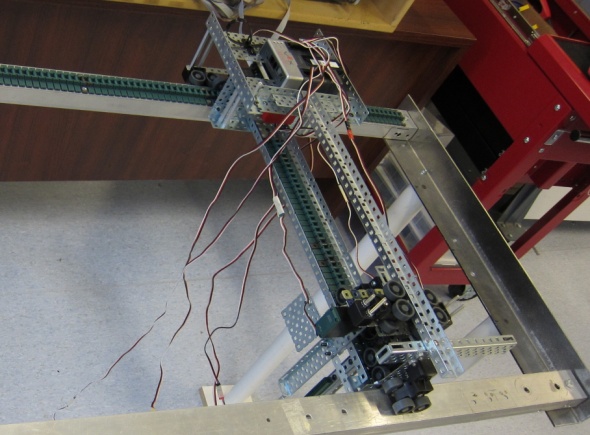
Quadriplegic Gantry

Team 341 Iron Eagles

Brief Description: A 5-motor gantry (figure 1) constructed of VEX parts that can be operated by a quadriplegic through head motions only.

Mechanical System: The gantry structure is 50 inches long by 25.75 inches wide by 35 inches high. A 2-VEX motor carriage (figure 2) carries the gantry gripper (figure 3) on perpendicular tracks the length (x-axis) and width (y-axis) of the gantry structure. A third VEX motor raises and lowers (z-axis) the gripper. A VEX servo opens and closes the gripper, while a fourth VEX motor rotates the gripper in the horizontal plane.

Electrical System: Two VEX yaw rate sensors are mounted on a hard hat that is worn by the operator (figure 4). The sensors are mounted in orthogonal planes: a yaw sensor on the top of the hat senses motions in the horizontal plane and a pitch sensor mounted on the side of the hat senses motions in the vertical plane. A VEX limit switch operated by a sideways (roll) motion of the operator’s head, selects one of 3 possible gantry operating modes. Three VEX quadrature encoders, one for each of the principal gantry motors, measure the distances traversed in the plane. Three VEX limit switches located at the starting positions of the 3 principal motors provide a ‘hard home’ starting point for the gantry carriage and gripper.

Operating System: The operating system is written in EasyC v4 for Cortex (v4.0.2.8). At startup, the 3 principal gantry motors autonomously move the carriage and gripper to their hard home starting location using the limit switches to sense the stops. The operating system starts in mode 1 which allows the operator to move the carriage along the gantry x axis, using a yaw motion of the head, and along the y axis with a pitch motion of the head. The output of the 2 VEX yaw rate sensors is calibrated such that motor speeds are proportional to head displacement in degrees. A 45o rotation of the head drives the motors at top speed. The limit switch mounted on the hard hat implements modes 2 and 3 by successive tilts of the operator’s head. Mode 2 allows the operator to raise or lower the gripper (pitch motion of the head) and to open or close the gripper (yaw motion of the head). Mode 3 allows the operator to rotate the gripper in the horizontal plane (yaw motion of the head). The 3 quad encoders prevent the motors from overdriving the tracks in any direction. An LED in the field of view of the operator indicates the operating mode: a single repeated blink for mode 1, double blinks for mode 2, and triple blinks for mode 3.