Robot Hardware Documentation for Project 3
April 30, 2003
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1.0 Overview

The body of our robot is approximately a nine-inch cube, borne upon four wheels. Two walls, one each on the left and right hand sides, meet a large cradle structure that serves as the roof of the cube. This provides an upside-down 'U' shape that allows blocks to pass through the undercarriage of the robot. The open space in the undercarriage of the cube body is railed in front with angle beams to ensure that any orange blocks within ± 5 inches of robot center will be directed toward the back of the robot, where a cage hangs between the two walls. The overall body design is shown in Figure 1.

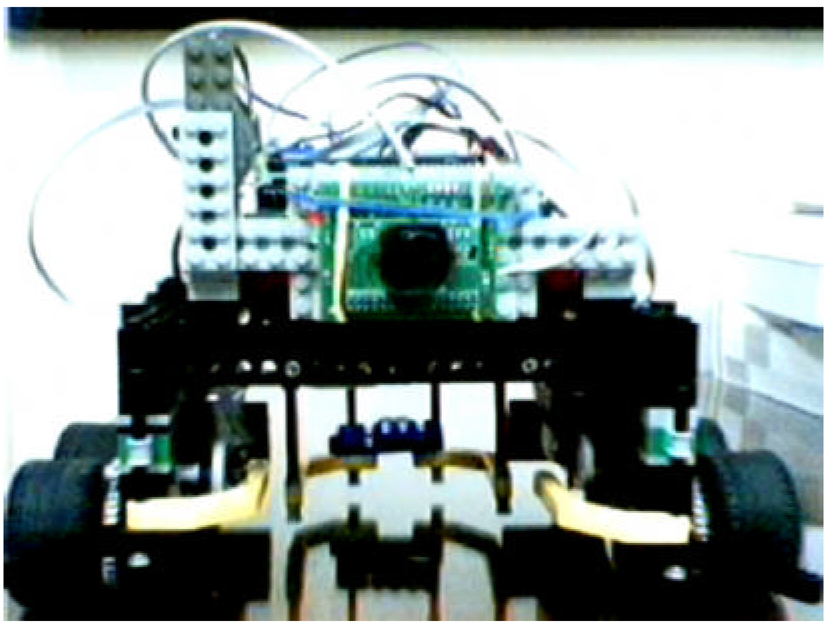

Figure 1 - Front View

2.0 Locomotion

The craft has four wheels, two each on the left and right sides. The wheels are the medium-radius, thick-walled type. These are suitable for increased traction, which translates to increased control. They are mounted on the outside of the cube, at the bottom of the walls, centered slightly forward. There are two gray DC motors, one for each side, that drive the wheels. Each motor's drive axle bears an 8-tooth gear. The 8-tooth gear drives a 48-tooth gear on the axle of that side's rear wheel. The front wheels also share axles with 48-tooth gears, and each front wheel connects to a rear wheel via a 24-tooth gear between them. The apparatus appears in Figure 2. This transmission system ensures not only that each side's wheels turn at the same speed and in the same direction, but also that they are as close together as possible. There is a 5:1 gear ratio from the wheels to the motor driving them; this helps increase torque and reduce speed, which translates to increased traction. The robot itself is also quite heavy. The robot's wheels, gearing, and weight all help reduce slippage, which adds to the reliability of the robot's movement. The robot also has a large distance between its right and left wheels (about nine and a half inches from centroid to centroid), which yields the smallest deviation possible for straight motion, and greater precision when correcting the robot's course. Increased confidence in the vehicle's locomotion means that the team can use simple means to verify position, increasing the robot's efficiency and point-scoring capability.

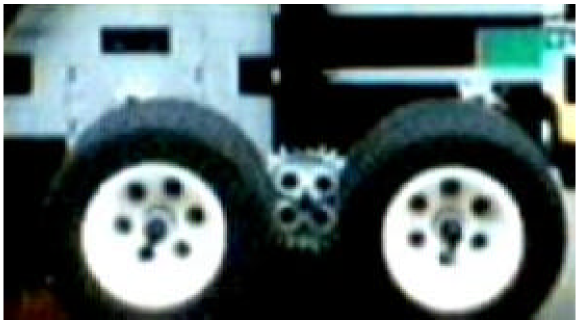

Figure 2 - General Drive Train

3.0 Block Containment

The cage (see Figure 3) has its own motor and gearing system. The cage itself hangs by an axle from the roof. This axle is attached to a 24-tooth crown gear that connects to another 24-tooth crown gear at right angles; one crown gear is horizontal, while the other is vertical. These two gears meet to translate rotational movement from a servo (which is mounted at the rear of the roof) to the cage. Figure 4 depicts this. The cage has three positions: open, lock, and release. When the cage is open, the single aperture faces the robot's direction of forward motion. When the cage is locked, it rotates ninety degrees so that the aperture faces the inner left wall of the robot. This basically closes the cage and prevents any blocks from entering or exiting it. When the cage is set to release, the aperture faces the rear of the robot, and the block is left behind when the robot moves away. The cage is designed to hold exactly one 2" block. If multiple blocks stack up within the body of the robot, only one will be captured when the cage locks, and only one will be delivered to a target square location at any one time. This design element helps maximize points because each time two blocks are left in a destination location at once, the loss from the optimal score is equal to 42 points (twenty possible points for getting each block into its corresponding target location, and one point lost for each of the two blocks in the destination location).

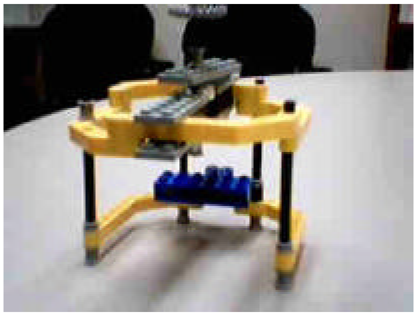

Figure 3 – Cage

Figure 4 - Cage Servo Interface

4.0 Sensors

Four different kinds of sensors populate the body of the robot. Figure 5 gives the locations of each type.

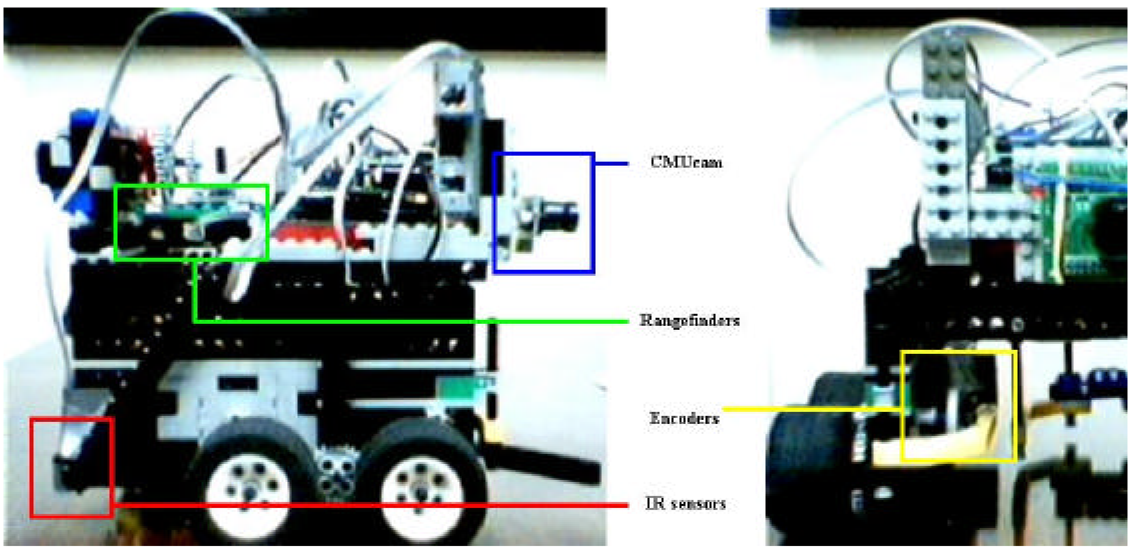

Figure 5 - Sensor Arrangement

4.1 Shaft Encoders

Each of the front wheels shares an axle with a 48-tooth gear. An 8-tooth gear is bound to this big gear. Each of these foremost 8-tooth gears shares its axle with a medium pulley wheel, which is in turn read by an encoder. Each encoder wheel has a 1:1 gear ratio with the motor driving it, giving outstanding resolution. The team found that the encoders return about 119 ticks per foot; in other words, a transition occurs on an encoder when its associated wheel travels approximately one tenth of an inch. Such precision is necessary for proper course correction, thus ensuring that the robot locates blocks and transports them to the correct locations.

4.2 Infrared Light Sensors

There are two IR sensors on the robot chassis, attached at the rear bottom corners of the vehicle's cubic body. The sensors are aimed at the ground to record the presence of black tape. These sensors are placed in this manner so the robot will align on the black tape surrounding the target locations and thus ensure dramatically precise locomotion.

4.3 Optical Rangefinders

Two optical rangefinders sit above the cage, peering down to detect if a block is present.

4.4 CMUcam

There is a CMUcam at the front of the vehicle, angled slightly downward so as to gain a good vantage of the area immediately in front of the robot. This is so it can gather general information about the orange and blue color content in the area.

5.0 Conclusion

The intent of this design is to generate a robot that will move precisely and confidently. The sensors above appear in order of priority to the project success. The team did not fully implement the sensory capabilities of the robot, so the rangefinders and CMUcam were not available for either run.