Parts List:

Car:
- 1 user manual
- 1 vehicle
- 1 Handyboard (onboard)
- 1 9V battery
- 1 short serial cable (modified)
- 1 log sheet
- 1 wiring diagram

Beacon:
- 1 brick
- 1 film canister with LED’s
- 1 9V battery

Warnings:
Although this system is as robust as we can make it, it is still possible for you to break it.

Therefore:
Operate only on a hard, flat, low surface such as concrete, tile, or wood flooring.
DO NOT operate on an elevated surface like a table or a desk.

NO Dropping
NO Moisture
NO Intentional breakage
NO Heavy objects on top of car
NO Pressure to the sidewalls.

Communicating between two Handyboards requires a modified serial cable.

Therefore:
USE ONLY THE PROVIDED SERIAL CABLE TO CONNECT TWO HANDYBOARDS TO EACH OTHER.

Using the wrong serial cable will damage the electrical components of your Handyboard. You will know if you are using the wrong cable by the smell of burning electronics coming from your Handyboard.
Operational Use

1. Check that the Onboard Handyboard software is loaded.
   a. Turn on the Onboard Handyboard
   b. If the LCD shows “OBHB waiting for start bytes”, then skip to step 2
   c. If the LCD shows something else, then skip to Troubleshooting A.

2. If the Onboard Handyboard was removed from the vehicle, place it in the front section of the cargo area, with the IR receiver pointed toward the front of the vehicle.

3. Place the vehicle on the ground.

4. Place your Controller Handyboard in the rear cargo area of the vehicle with the LCD toward the front of the vehicle.

5. Connect the provided serial cable (short) to the two Handyboards. DO NOT use the long serial cable that came with your Handyboard box or any serial cable other than the short one that came with the vehicle (see Warnings).

6. Set up your IR source
   a. Option 1: Provided IR Transmitter.
      i. Place the IR Transmitter in an appropriate location. The infrared transmitter should be level with the on-board Handyboard’s IR receiver. Use a significant weight to stabilize the transmitter as well as provide an impact point for the bumper. The provided brick or a few textbooks work well.
      ii. Make sure the 9V battery is connected to the Transmitter.
      iii. Turn on the Transmitter.
   b. Option 2: Remote Control.
      i. Obtain any remote control that sends IR codes.
      ii. To produce a “visible” IR signal, point the remote in the general direction of the vehicle and push any button.
      iii. To produce a “not visible” IR signal simply release the button.
      iv. Most remote controls (including the PRS clicker) have very strong signals compared to the provided transmitter. This means that the angle between the remote and the IR receiver on the Onboard Handyboard does not have to be precise. In a small room with several reflective surfaces, the IR signal from a remote will probably be visible at any angle.

7. Turn on your Controller Handyboard

8. Turn on the Onboard Handyboard.

9. Press the Start Button on your Controller Handyboard to start the simulation.

10. To stop the vehicle, press the stop button on your Controller Handyboard or press the nose of the vehicle, which will activate the microswitches.

11. To reposition the vehicle, pick up the vehicle, supporting the underside of the car, and hold it with the platform level to the ground.
12. When all simulation trials are over
    a. Turn off the IR Transmitter.
    b. Turn off both Handyboards
    c. Detach the serial cable.
    d. Remove your Controller Handyboard.
    e. Record any anomalies on the Log sheet that would indicate hardware problems.
Troubleshooting

Record any and all irregular behavior in the provided log sheet. If you don’t write it down, the TA’s won’t know to fix it.

All supporting C files are found in [http://web.mit.edu/16.070/www/project/](http://web.mit.edu/16.070/www/project/).

A. If the Onboard Handyboard software is unloaded follow these steps:
   1. Connect the Onboard Handyboard to a workstation using the serial i/o board and long serial cable that came with your original Handyboard box.
   2. Start Interactive C and Download the p-code if necessary.
   3. Download the serial_hb.c and SatSim_Car.c files to the Onboard Handyboard.
   4. Disconnect the Onboard Handyboard from the long serial cable.
   5. Go to step 1 of Operational Use.

B. If the Onboard Handyboard loses all power, follow these steps:
   1. Check that the 9V battery on the vehicle’s nosepiece still has a charge.
   2. Replace battery if needed. If you don’t have one of your own, you can get a new battery from the library.
   3. Check if the Onboard Handyboard software is loaded. If not, go to Troubleshooting A.
   4. Go to step 1 of Operational Use.

C. If the motors stop working, follow these steps to test the motors:
   1. Try a "suspend" test. Operate the vehicle while holding the chassis, and observe the wheels. If it appears to be operating correctly, check your flooring. You may be operating on a bad surface (e.g., carpet or rough terrain). Be sure to operate on a smooth, flat surface like wood, concrete or linoleum flooring. If the vehicle does not appear to be operating correctly, continue with step 2.
   2. Download motor_test.c to the Onboard Handyboard.
   3. Follow the attached wiring instructions to place the wires into the correct ports.
   4. Run the program, and observe the following behavior:
      a. Car moves forward when start button is pressed
      b. Knob changes motor power level (goes faster or slower as knob is turned)
      c. Stop button stops car.
   5. Evaluate behavior:
      a. Car works as expected with motor_test.c: the problem is with your controller.
      b. Car moves backward or spins: check the wiring diagram and repeat the test.
      c. Car does not work with motor_test.c: record the problem in the logbook and return the car to the library.
D. If the IR beacon stops working (LED goes out), follow these steps:
   1. If the red LED goes out fast or fails to come on, and anything heats up and/or starts smoking, there is a short circuit somewhere. Return the beacon and get a new one, and describe the problem in the log sheet.
   2. If the LED slowly faded out, it means the battery is dead.
   3. If the LED is on but faint, and you have trouble detecting the signal, then the battery is very weak.
   4. Replace battery if needed. If you don’t have one of your own, you can get a new battery from the library.

E. If the IR beacon is working but the vehicle never detects a signal, follow these steps:
   1. Check that the Onboard Handyboard’s IR receiver and cover are pointed towards the front of the vehicle (see Figure 1).
   2. Check that the Onboard Handyboard still has power. (Troubleshooting B)
   3. Check that the Onboard Handyboard software is still loaded. (Troubleshooting A)
   4. Use a remote control or a PRS clicker to test the IR receiver:
      i. Aim the remote at the Onboard Handyboard’s IR receiver and hold down a button.
      ii. The signal from a remote should be strong enough to be read even if the angle and level is slightly off.
      iii. If the Handyboard DOES NOT SEE the remote signal, and the Handyboard is on and running the provided software, return the car and record the problem in the log sheet.
      iv. If the Handyboard sees the remote signal, then check the orientation and strength of the IR transmitter (see troubleshooting D).

![Figure 1 - Position of IR receiver on Onboard Handyboard](image-url)
Wiring Diagram and Instructions

The two motor wires are red and black, and can easily be seen emerging from the car through a small hole in the platform.

The black and white wires run from the switches, and emerge from the front of the handyboard.

Insert the motor wires, with the red wire on towards the power switch, in ports 1 and 2. If they are not inserted correctly, the motor will not work. If you are unsure, insert the motor connectors, and count the number of open ports to the side. There should be 3 open ports to either side if the vehicles are wired correctly.

Insert the switch wires into ports 7 and 9. The black wires should go into the bottom row of connectors, with the white wires going into the top row.

Read and understand motor_test.c, then run it.

If the car does not travel forward, stop the program via the stop button or the switch inputs, and flip only one of the motor connectors such that it is in the same port, but the red wire is now furthest from the power switch. Repeat as required to obtain a car that travels forward.
Log Sheet

Car_______________________

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<th>Problem Description</th>
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