SRC Roundtable meeting: April 16 – 17, 2013:

Programming your robot for driving, Mechanical model building and technical data;

1. **Programming your robot for driving;**
    a. Once your chassis are assembled, it's time to get your robot moving! Go to the www.srcvb1.weebly.com website and download the transmit and receive code. There are 6 files in all and they ALL must be stored in the same folder before you can program your robot.
    b. Mount your circuit board to the robot chassis
    c. Mount the battery to the robot chassis.
    d. Make two female disconnect wires to attach from the circuit board to the battery. Color one lead black to plug onto the negative terminal. Be sure you solder the wire connections.
    e. Connect the 12v Power transformer to your transmitter board. (Striped side is positive)
    f. Connect the PS2 dongle to the transmitter board. (A photo of this connection is in the back of this packet.)
    g. Connect a PS2 controller to the Dongle.
    h. Connect a servo to pin 16 on the receiver board. The white lead goes closest to the propeller chip.
    i. Download the "TRANSMIT" code to the transmitter through the USB cable and prop plug. (Reminder: The SILVER side of the PROP PLUG always faces outward – away from the board)
    j. Move the PROP PLUG to the "RECEIVER" board on the robot. Download the "receiver" code to the receiver board.
    k. Cut the power off to both boards and place a "Matching Pair" of XBEE modules in the boards. (The angled side goes closest to the Propeller Chip.)

Power up the robot control board and the transmitter board. Press the analog button on the PS2 controller. The light should come on in the middle of the controller.

    l. Using a small screwdriver, adjust the small gain control on the side of the servo connected to pin 16 until the servo comes to a complete stop.
    m. Place another servo on pin 18 and adjust the gain control on that servo until that wheel stops also.
    n. At this point, you should be able to push the left joystick forward and see the servos turn and then push the joystick backward and see them turn in the opposite direction.
    o. Once this is control is established, install the servos in your chassis with the wheel mount closest to the front of the robot and flush with the top edge of the servo mounts.
    YOU ARE DRIVING! YEA!
2. **Making changes to Robot Code to add a lifter or arm:**
    a. The TRANSMITTER code will never be modified. Once you have downloaded the code onto the transmitter board using the F11 command, you should be finished with that code.
    b. The RECEIVER code is the code that should be modified to control other items on the robot.
    c. Using the handout provided to you in the back pages of this document marked "RECEIVER CODE", make additions and changes to the code noting the following examples; (Discussion)
        i. Controlling a servo with a Button (Pulse action)
        ii. Controlling a servo with a Button (Smooth action)
        iii. Controlling a servo with a joystick

3. **Setting up your Transmitter Control Caddy**.
    a. Use the photos provided in the handout and screw your handle onto the base.
    b. Attach the robot control board placing the switch on the outside edge. It is best to place the board onto some small plastic spacers to keep from flexing the board by screwing it directly to the base. These small plastic spacers came in your VEX hardware supplies. If you don't have the spacers, its ok to place a small nut under each corner screw to lift the board off the base just a small amount to keep from flexing the board when its screwed into place.
    c. Place the Power transformer into its mounting holes as shown in the photo. Run the wire from the transformer around the handle and through the hole and connect to the green power terminal on the RCB. Be sure the STRIPED side of the wire goes into the positive terminal. Also be sure to "tin" the power wires before inserting them into the green power terminal. This keeps fraying wire to a minimum and also prevents possible shorting of the supply. No wire should be seen sticking out of the green power connector. Insulation should butt up to the edge of the connector. This also prevents shorting issues.
    d. Run the PS2 Dongle through the hole in the handle and connect the PS2 Dongle to the RCB as shown in the picture. Place the dongle in between the handle and Power transformer and, using the wire clamp, screw the dongle in place on the base.
    e. Next, plug the PS2 controller into the Dongle and wrap the cord around the handle.
    Your Transmitter Control Caddy is ready for use!
4. **Building arms, scoops and mechanical linkages:**
    a. The key to building any servo attachments is that you must think LIGHT! A servo can only provide 43 in ozs of torque. Although these numbers don't mean a lot to you, technically speaking, it means that it cannot lift a great deal of weight. If you plan to extend an arm, scoop or gripper you must keep distances as short as possible and the choice of materials as light and strong as possible. The metal provided in the kits must be used sparingly and weight of the parts must be considered.
    b. Thin plexiglass makes a good arm material because it's light and rigid. The whiteboard that the chassis are made of DOES NOT work well as an arm material due to weight.
    c. To create an arm, scoop or mechanical linkage, the material must be mounted to the HORN of the servo. This may be done with machine screws and nuts or in some cases small wood screws. Generally only 2 screws will provide a sufficient support 180 degrees apart.
    d. In my research, I have found that one servo can generally only lift one servo setup as a small gripper. The arm length has to be considered because more force is required to lift the gripper servo as the length increases. There is a definite limit.
    e. The "SAND" material is actually pretty heavy and my work with my students has shown that a smaller, more narrow, scoop is practical. A wider scoop often will not push through the sand. Holes need to be provided in the scoop for the sand to filter out.
    f. The SIMPLEST way to move materials from the sand to the bucket is to make a scoop that can pick items up when rotating in one direction and then dump them when rotated in the opposite direction. One servo attached to a "BOOM" that moves over the sand pit works pretty well.
    g. Students can make the scoops or another way is to determine a rough size and shape of what you want and go to the Dollar store and find something in a similar shape that you can cut down or modify. Keep "LIGHT WEIGHT, SIZE and SHAPE" as the determining factors.

5. **Technical Data that SHOULD NOT be overlooked;**
    a. In our research, we have found that the rubber tires will come off the wheels unless they are glued onto the wheel. I have not yet experimented with adhesives to attach the tires, but I will be trying the simplest and cheapest stuff first such as elmers glue. Adhesives that bond to rubber and plastic may be better, so maybe we can share our experiences with this. If you find an adhesive that works..please share it with me so I can pass it on to everyone.
    b. There are several TECHNICAL aspects related to getting the RCB receiver communicating with the transmitter and vice versa.
        i. Your BATTERY voltage **must be** between 10.7 volts and 12.4 volts. If the battery falls below the 10.7 volts, your robot will act abnormal. It might move in a jerking fashion because the signal is going in and out. It might act like you are losing your RF signal and not respond to your PS2 control. It might just sit still. If this IS the problem, when you turn the robot over, and press any PS2 controller button or joystick, the GREEN light on the RCB (on the robot) will go out. (Charge your battery and it will be resolved!)
        ii. If the ANALOG button in the middle of the PS2 controller is not lit, your servos will likely just run with no control. Be sure it's lit when you try to control the robot.
        iii. The DONGLE connections that plug onto the transmitter board can occasionally act like they are not connected. When this happens, generally your robot will not be moving, but the robot does NOT respond to the PS2 controller. If you take your fingers and press lightly on the dongle connectors that are pushed onto the header pins on pins 12 – 15 on the transmitter and push the left joystick on the PS2 controller at the same time, you can usually pin-point the issue. It's usually either a poor solder joint on the RCB or a loose wire on the dongle.
        iv. If you want to TROUBLESHOOT the remote control aspect of the robot, you must start with opening the Parallax serial terminal software. This software allows you to see whether or not the RCB is seeing the PS2 controller. It allows you to activate the PS2 buttons and joysticks and look at the data on the computer screen so that you KNOW it's coming in. This helps you rule out remote control issues, or PS2 issues or XBEE module issues. It also helps you determine if your problem is robot code.
        v. To operate the Parallax Serial Terminal software (PST), open the program from your desktop or start menu. At the bottom it will say "Com Port": This MUST be set to the same com port you are using to load code on your robot. When you first press F11 on the keyboard, the com port pops up real quick as it starts to download. The BAUD RATE must also be set to 9600. This is the baud rate for the PS2 controller so the two must match. (The baud rate is the rate of data transfer)
        vi. If you place the PROP PLUG onto the RCB and load the code, you can open the PST software and, with the Prop Plug connected, you should see two rows of numbers at the top followed by the joystick data below it. The joysticks should say 128 if they are active. When you move the joystick, you should see the joystick data numbers change on the computer screen. This lets you know that the RCB receiver is getting the signal from the transmitter. If you press a button on the PS2 controller, you should see numbers at the top change that correspond to the button you are pushing. If the joysticks read 255 this generally means you DO NOT have an RF connection with the XBEE modules.

6. **All about XBEE modules:**
    a. The XBEE module is a wireless modem. Its takes two xbee modules to make a robot work wirelessly. These modules have been previously programmed. Each XBEE PAIR has a specific CHANNEL and frequency. They are programmed so that they don't overlap frequencies. They are programmed to operate in a 25 foot range. There are 12 available channels which are; C,D,E,F,10,11,12,13,14,15,16 and 17. The XBEES provided to your school MUST BE USED for the SRC main event so take care of them like they are your personal jewelry. They cost about $35 each! Each school will get 4 XBEE modules so that they can run 2 robots at a time. You will find that with battery operation, this works well. Once one team battery dies (8 to 10 minutes) the next team can practice. I will need these XBEE modules wrapped carefully and returned to me in the PONY NO LATER than May 28, no exceptions. I have to account for them all on each Level 1 arena for game day!
    b. The XBEE modules plug into the board with the angled side facing the propeller chip. BE ABSOLUTELY SURE that you line up the pins carefully as you plug the xbee into the socket. It's real easy to miss by 1 pin in either direction. When you remove the xbees, pull straight UP so that you don't bend the pins. Teach your students how to remove them carefully because they will need to do so on game day.
    c. The XBEES are marked in several ways. The marking relates to the area and channel for which they are assigned. Such as A111T: This would be Area 1, Channel 11, Transmit.
    The MATCHING XBEE for this pair would be A111R: Area 1, Channel 11, Receive .
    You MUST match the xbees up in order to use them on a robot and transmitter. If you DON'T have a matched pair, they DO NOT communicate. At the event, there will be groups of arena tables. There will be three tables to a group. Each table will have 4 separate channels on which they operate and each group will have 12 separate channels. Each GROUP will be spaced 50 feet apart from one another to minimize RF conflicts. However, this is not to say that small jitters might occur with robots from time to time. Anytime that you place that much RF in one area, you are bound to have a few issues, however, we feel with this setup interference should be minimal.
    d. When students check in to their assigned table at the event, they will be given the pair of XBEE's for their robot. They will install them and then test their robot for operation prior to starting the round. They will need to let the judge at the table know if there is a control issue so that they can try a second pair of XBEES if they have an issue.