

WILSONVILLE ROBOTICS

FRC TEAM 1425 “ERROR CODE XERO”

CARTBOT CONTROL SYSTEM

31 MAY 2017 10:42

ISSUES/TBD

1. line fuse rating
2. motor breaker rating
3. control system fuse/breaker rating
4. is there a minimum length of time in POWER ON (disabled and joystick released) before going to READY?
5. warning messages in POWER ON if deadman switch and/or joystick aren't released? Or perhaps a new UNSAFE state that's distinct from POWER ON because it doesn't show credits?
6. Is there a minimum length of time in READY (with joystick released) before going to ENABLED?
7. power-on screen message (team and/or individual credits?)
8. add electrical schematics/specifications
9. verify the chassis and control panel connector types
10. document the chassis-to-control panel cable pinout
11. calibrate and document the joystick-to-motor controller curves
12. verify joystick X/Y axes and motor controller L/R connections
13. Check the battery low-voltage thresholds for reasonable behavior under load. We don't want unnecessary “charge required” faults but we also want to protect the battery.
14. Check the battery voltage bar graph scaling and adjust spec/code as needed for best utility.
15. Disable the backlight to conserve power when CartBot has been in POWER ON state for more than 3 (TBD) minutes or when the battery voltage is dangerously low (below 10.0V (TBD))
16. Are there other types of faults that we could reasonably detect?

CHASSIS

CONNECTORS

- IEC 320 C5 power inlet with detachable cord, charger
- Anderson Power Products SB50, red, battery
- cable with molded D9M connector, control panel

FUSES/BREAKERS

- 110V fuse holder (3AG **3A**) for charger power
- 2 **40A** snap-action breakers (internal) for motors
- 1 **3A** fuse (internal) for control system

INDICATORS

- charger power (green)
- charger charging (red)
- decorative lighting?

CONTROL PANEL

CONNECTORS

- D9F connector, chassis cable

CONTROLS

- main power switch
- 2 motor enable (deadman) switches, wired in parallel
- Joystick, X-Y analog, spring return to center

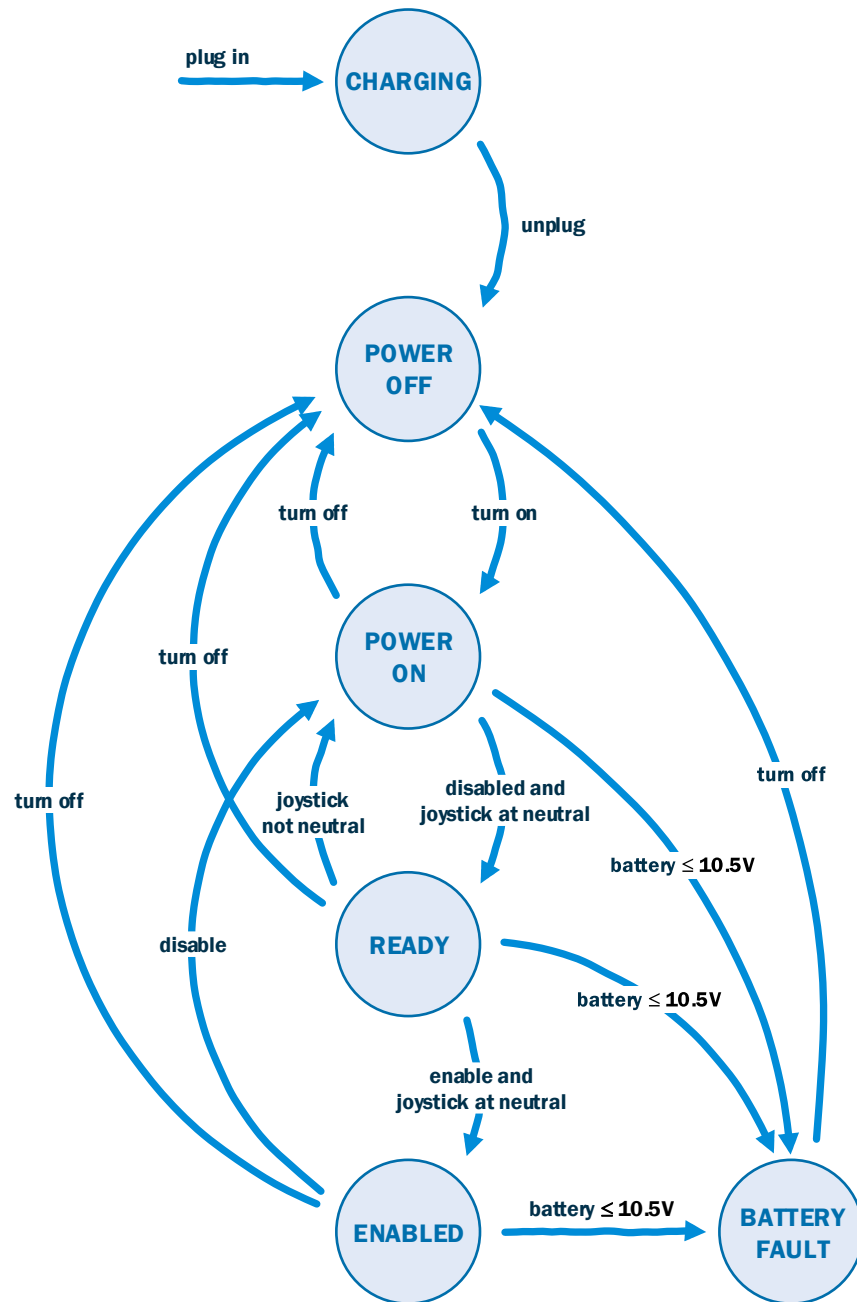
INDICATORS

- 4-line x 20-character LCD display, LED backlight, white-on-blue
- speaker/buzzer?
- decorative lighting?

OPERATING STATES

There are 6 defined operating states: POWER OFF, CHARGING, POWER ON, READY, ENABLED and BATTERY FAULT. Conditions and outputs for each state are described below.

For safety, software shall not allow transitions to the ENABLED state when the joystick is not centered.



POWER OFF

CONDITIONS

- charger power disconnected
- main power switch OFF

OUTPUTS

- charger power indicator OFF

- charger active indicator OFF
- Arduino power OFF
- motor controller power OFF
- 4x20 display blank, backlight OFF



Power off

CHARGING

CONDITIONS

- charger power connected
- main power switch may be ON or OFF

OUTPUTS

- charger power indicator ON
- charger active indicator OFF, FLASHING or ON (depending on battery charge status)
- Arduino power OFF
- motor controller power OFF
- 4x20 display blank, backlight OFF



Charging

POWER ON

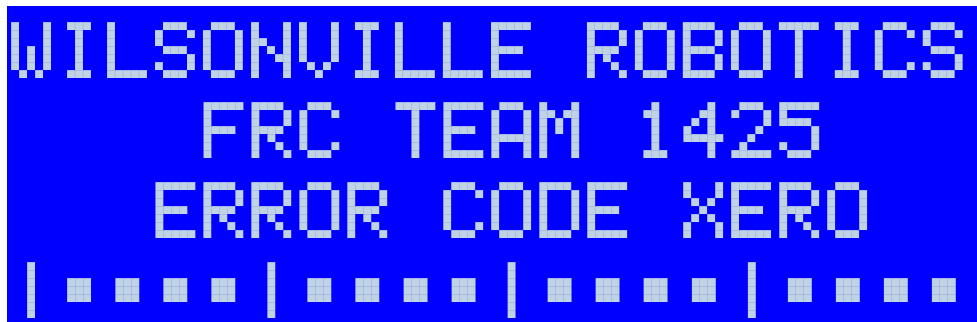
CONDITIONS

- charger power disconnected

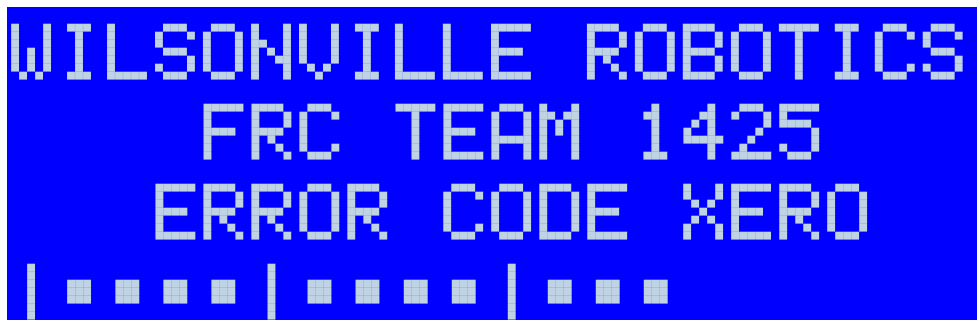
- main power switch ON
- battery voltage > 10.5V

OUTPUTS

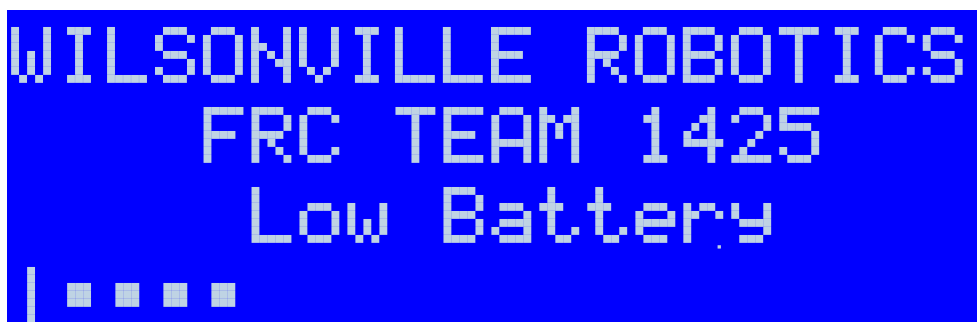
- charger power indicator OFF
- charger active indicator OFF
- Arduino power ON
- motor controller power OFF
- display backlight ON
- display rows 1-3 show credits (text TBD; scrolling?)
- display row 3 changes to “Low Battery” warning when the battery voltage is less than 11.2V
- display row 4 shows battery voltage bar graph, 10.5V..12.4V with 10.5, 11.0, 11.5, 12.0 distinguished as shown



Power on, full charge ($\geq 12.4V$)



Power on, 11.8V



Power on, low battery (10.8V)

READY

CONDITIONS

- charger power disconnected
- main power switch ON
- both safety switches RELEASED
- joystick at NEUTRAL
- battery voltage > 10.5V

OUTPUTS

- charger power indicator OFF
- charger active indicator OFF
- Arduino power ON
- motor controller power ON
- motors STOPPED
- display backlight ON
- display row 1 shows "READY"
- display rows 2-3 blank
- display row 3 changes to "Low Battery" warning when the battery voltage is less than 11.2V
- display row 4 shows battery voltage bar graph, 10.5V..12.4V with 10.5, 11.0, 11.5, 12.0 distinguished as shown



Enabled, not moving, full charge ($\geq 12.4V$)



Enabled, not moving, 11.8V

READY

Low Battery



Enabled, not moving, low battery (10.8V)

ENABLED

CONDITIONS

- charger power disconnected
- main power switch ON
- either one or both safety switches PRESSED
- battery voltage > 10.5V

Once CartBot has entered the ENABLED state, it shall not return directly to the READY state.

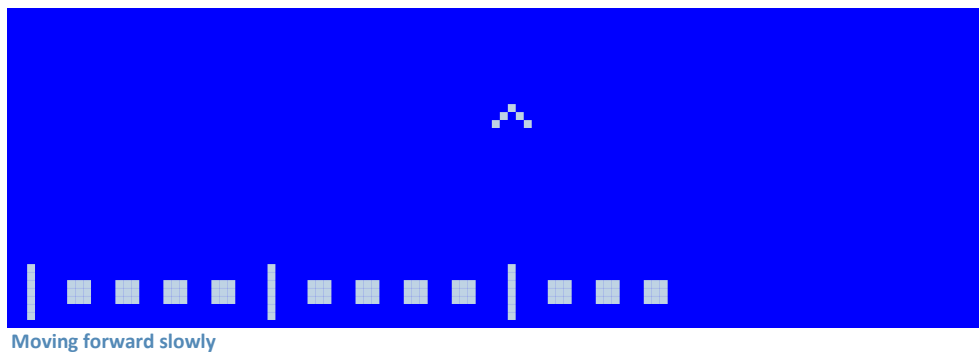
OUTPUTS

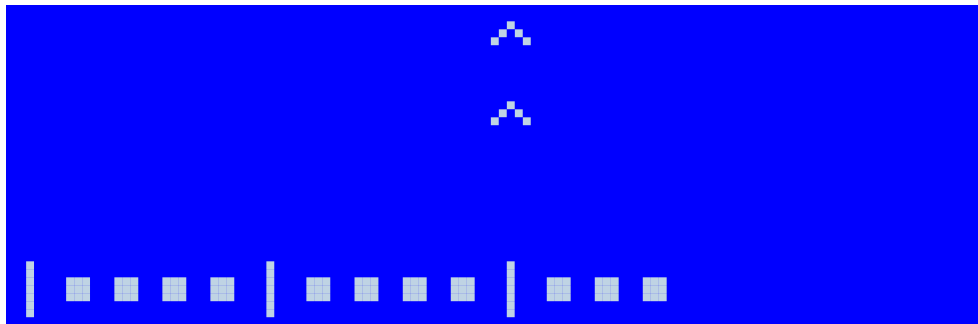
- charger power indicator OFF
- charger active indicator OFF
- Arduino power ON
- motor controller power ON
- motors MOVING as directed by joystick

Motion isn't linear! Only forward motion has a "fast" speed. Reverse and turn-only motions are limited to "slow" speed. Actual speeds TBD.

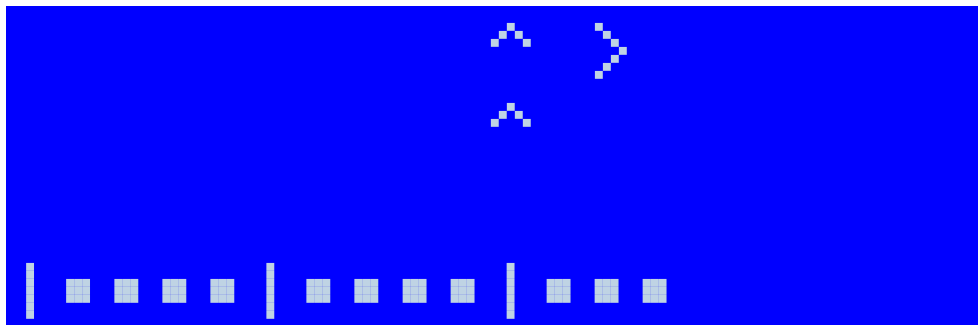
- display rows 1-2 show direction and speed
- display row 3 blank
- display row 3 changes to "Low Battery" warning when the battery voltage is less than 11.2V
- display row 4 shows battery voltage bar graph, 10.5V..12.4V with 10.5, 11.0, 11.5, 12.0 distinguished as shown

These pictures are approximations; the display should use the HD74480 A02 arrow characters rather than the ASCII characters shown here.

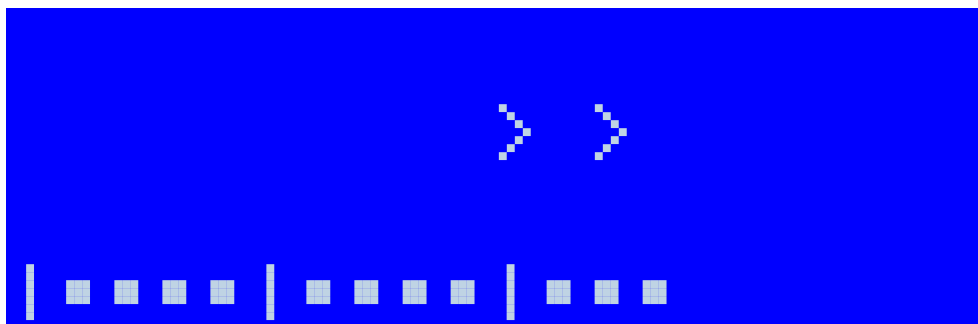




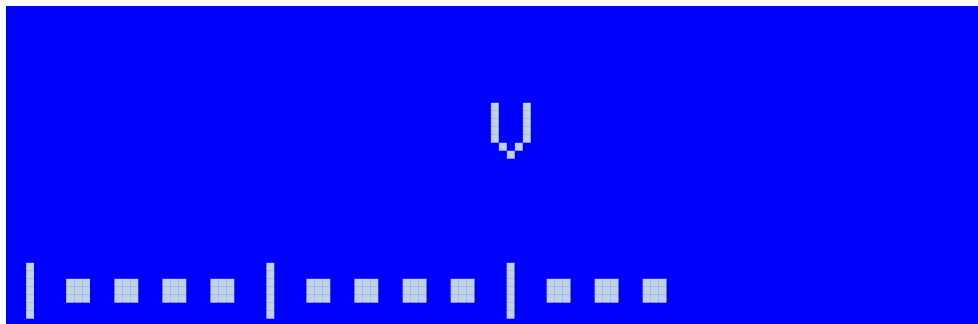
Moving forward faster



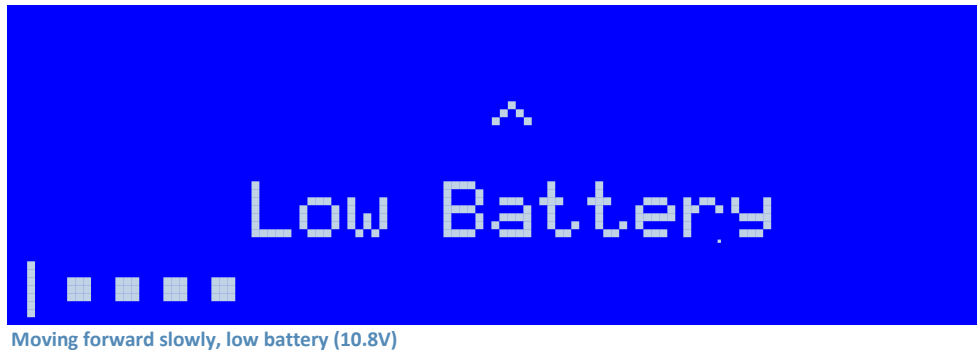
Moving forward and turning right



Turning in place



Moving backward



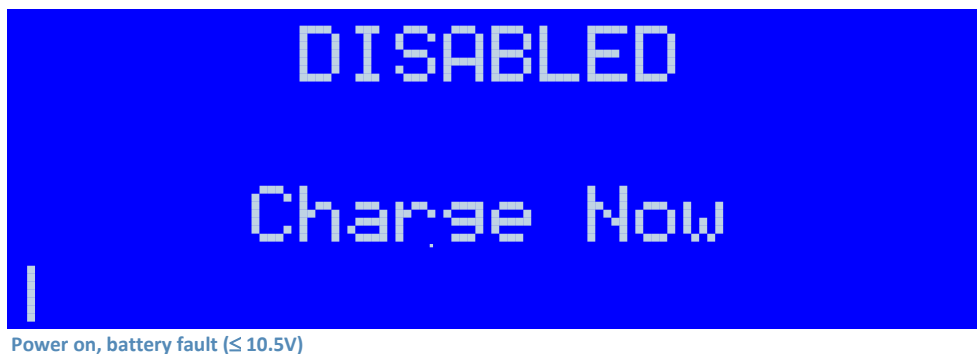
BATTERY FAULT

CONDITIONS

- charger power disconnected
- main power switch ON
- battery voltage $\leq 10.5V$

OUTPUTS

- charger power indicator OFF
- charger active indicator OFF
- Arduino power ON
- motor controller power ON
- motors STOPPED
- display backlight ON
- display row 1 shows "DISABLED"
- display row 2 blank
- display row 3 shows "Charge Now"
- display row 4 shows battery voltage bar graph, 10.5V..12.4V with 10.5, 11.0, 11.5, 12.0 distinguished as shown (in this state, the row will be blank or showing just the 10.5V marker)



BATTERY VOLTAGE - ANALOG TO DIGITAL CONVERSION

divider top 10000
divider bottom 4700
Vref (Vcc) 5.00

	Vin	Vdiv	AnalogRead	scaled
Vmin	10.50	3.36	686	0
Vmax	12.50	4.00	817	20
	10.40	3.33	680	-1
	10.50	3.36	686	0
	10.60	3.39	693	1
	10.70	3.42	699	1
	10.80	3.45	706	3
	10.90	3.49	713	4
	11.00	3.52	719	5
	11.10	3.55	726	6
	11.20	3.58	732	7
	11.30	3.61	739	8
	11.40	3.64	745	9
	11.50	3.68	752	10
	11.60	3.71	758	10
	11.70	3.74	765	12
	11.80	3.77	771	12
	11.90	3.80	778	14
	12.00	3.84	784	14
	12.10	3.87	791	16
	12.20	3.90	798	17
	12.30	3.93	804	18
	12.40	3.96	811	19
	12.50	4.00	817	20
	12.60	4.03	824	21
	12.70	4.06	830	21
	12.80	4.09	837	23
	12.90	4.12	843	23
	13.00	4.16	850	25
	13.10	4.19	856	25
	13.20	4.22	863	27

13.30	4.25	870	28
13.40	4.28	876	29
13.50	4.32	883	30
13.60	4.35	889	30
13.70	4.38	896	32
13.80	4.41	902	32
13.90	4.44	909	34
14.00	4.48	915	34
14.10	4.51	922	36
14.20	4.54	928	36
14.30	4.57	935	38
14.40	4.60	941	38