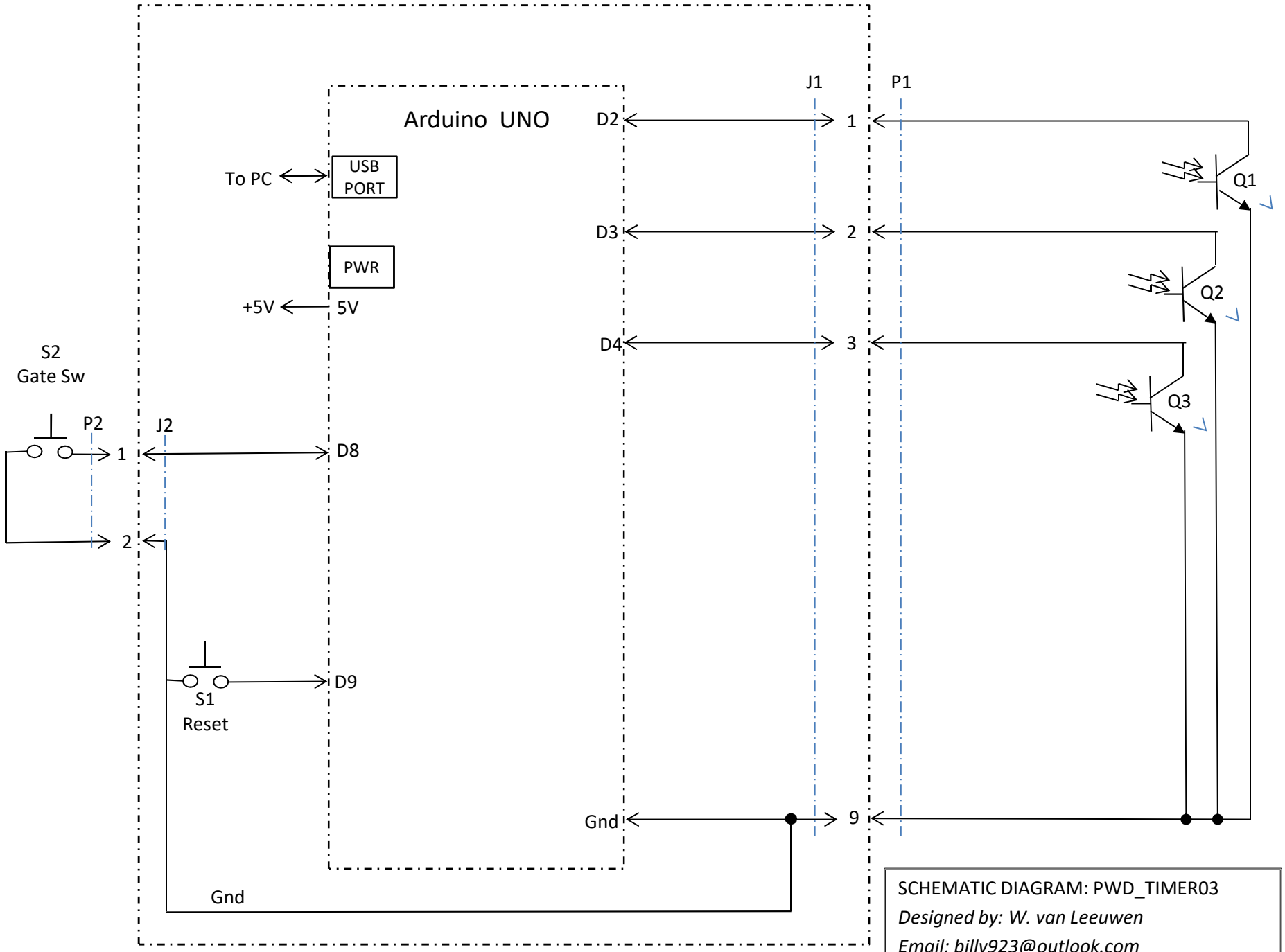


* R1 – R5 are optional. See design notes

PWD_Timer03 Schematic Diagram

Suggested Parts List*

Ref.	Qty	Description	Part No.	Manufacturer
Q1 – Q3	3	NPN IR Photo Transistor/Diode **Note**: If using an incandescent light source to illuminate the sensors you can also use 3DU5C as an alternate.	PT334-6B or: 3DU5C	EVERLIGHT ???
S1	1	Miniature pushbutton switch, SPST N.O.	Various	(See eBay)
S2	1	Miniature roller plunger switch, SPDT or: Miniature roller arm switch, SPDT	CN0103 CN0138	TEMCo TEMCo
P1	1	Plug, D-Subminiature 9-Pin Male	DS-9P/T-P10	Pan Pacific
J1	1	Jack, D-Subminiature 9-Pin Female	DS-9S/T-P10	Pan Pacific
P2	1	Plug, 2-cond. 3.5mm Mono Audio/Power male plug	KM2PB	Amphenol Audio
J2	1	Jack, 3.5mm Mono Audio/Power Female Jack, Panel Mount	11W07	Switchcraft
--	1	Circuit Board: Arduino UNO	See www.Arduino.cc	Arduino

*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors).
Parts list does not include enclosure (box) or mounting hardware (screws, circuit board standoffs, etc.).

PWD_Timer03 Schematic Diagram

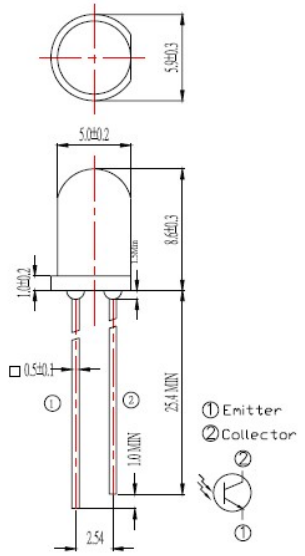
Design Notes

- This design takes advantage of the Arduino internal pullup resistor feature by issuing a 'pinMode(X, INPUT_PULLUP)' command for pins D2, D3, D4, D8 & D9 (see the 'setup' section of the Arduino PWD Timer source code). Hence, no external pull-up resistors are required for these inputs. However, if you plan on using the timer outdoors or in a place with bright ambient lighting conditions, an external pull-up resistor on input pins D2 – D3 may be required. A value from 4.7K-ohms is typical but may vary depending on the severity of the ambient light conditions. The lower the resistance the less sensitive the sensor becomes. If too sensitive, stray ambient light may prevent the sensor from tripping when a car passes over it. These resistors may also be required if you mount the photo sensors in a configuration such that it remains exposed to a fair amount of ambient light when the car interrupts the light beam.
- The Gate (race start) switch (S2) is mounted to the Gate such that the switch plunger is depressed when the gate is closed. When the gate is opened (cars released) the switch plunger extends (switch contacts open).
- The Reset switch (S1) has a normally open (N.O.) set of contacts
- Optical Sensors Q1 – Q3 are imbedded in the track at the finish line of each lane. Infrared LEDs or incandescent lamps are mounted over the finish line to provide a light source for the sensors.
- 5 VDC power is supplied by the PC through the USB port cable. A separate power source to the Arduino UNO circuit board is optional.

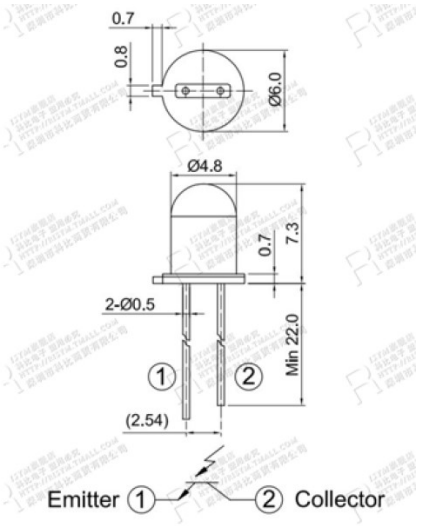
PWD_Timer03 Schematic Diagram

Design Notes (Continued)

- Q1 – Q3 PT334-6B Sensor pinout orientation (Bottom View)
  - Emitter (1) (long lead): Wired to Gnd
  - Collector (2) (short lead): Wired to Arduino input pin

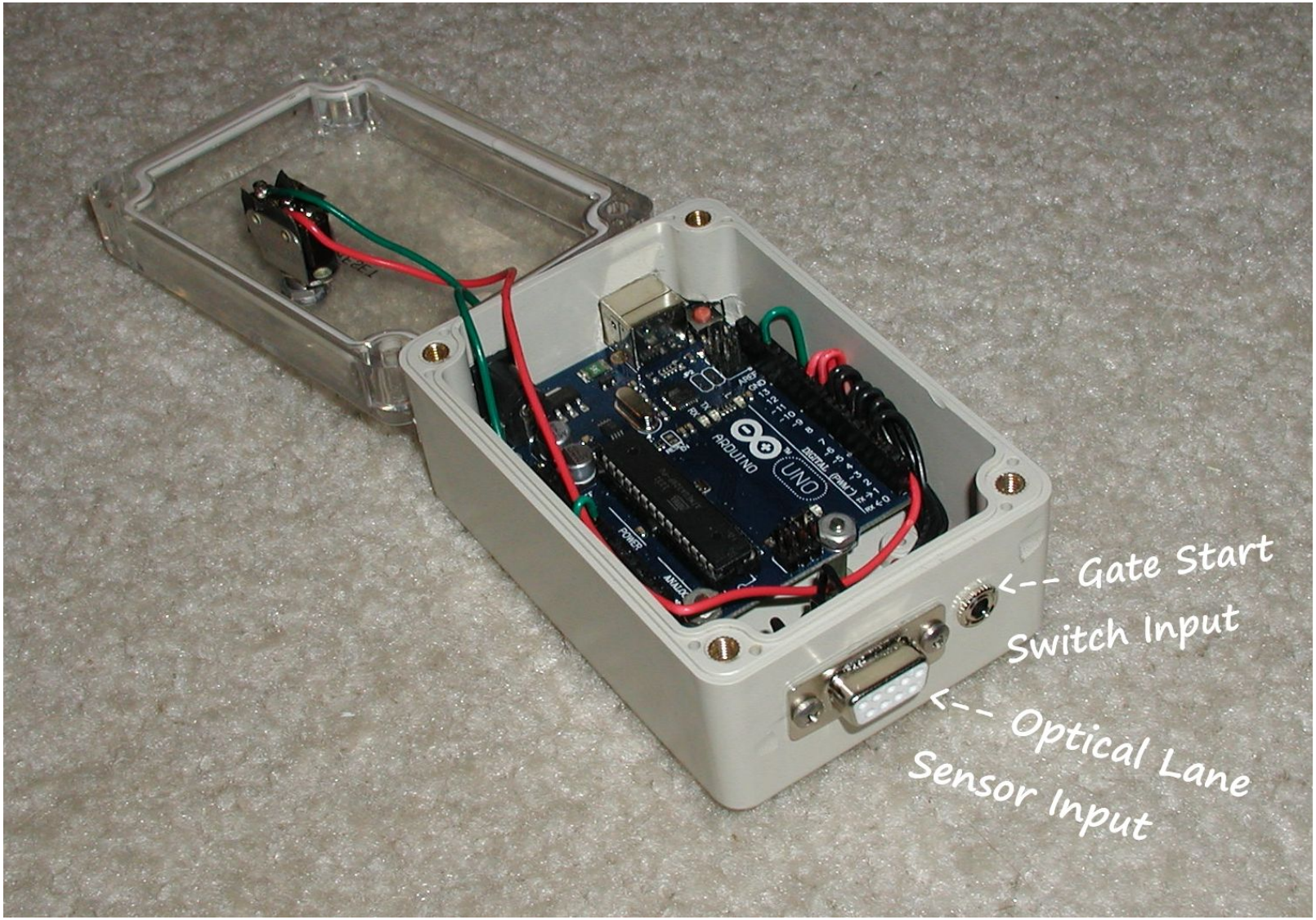


- Optional - Q1 – Q4 3DU5C Sensor pinout orientation (Bottom View)
  - Emitter (1) (long lead): Wired to Gnd
  - Collector (2) (short lead): Wired to input pin



- **Caution:** Do not use “photo resistors” as the optical lane sensors. Photo resistors have a slow response time and a potentially large lag time. Use Photo transistors or photo diodes only.

Example Build

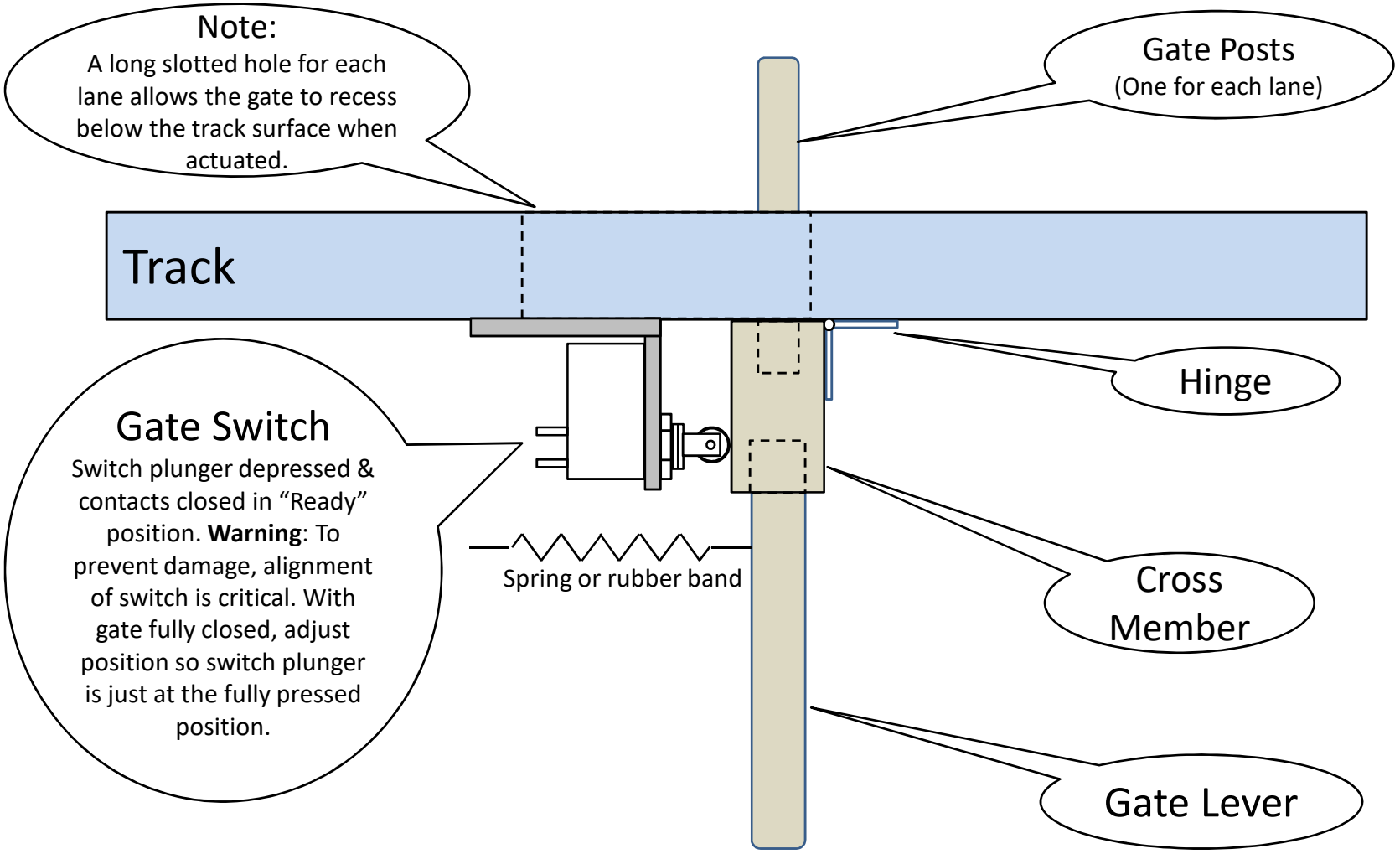


PWD_Timer03 Fabrication Notes

- 22 Gauge solid hook-up wire was used on the connecters and switches to make it easy to plug them into the Arduino board pins.
- The plastic box (*Plastic Waterproof Cover Clear Electronic Project Box Enclosure Case 100x68x50mm*) shown in the previous slide was purchased on EBay for $2.69.

- **Novice/beginners in circuit wiring**: See the wiring sketch at the end of this document.

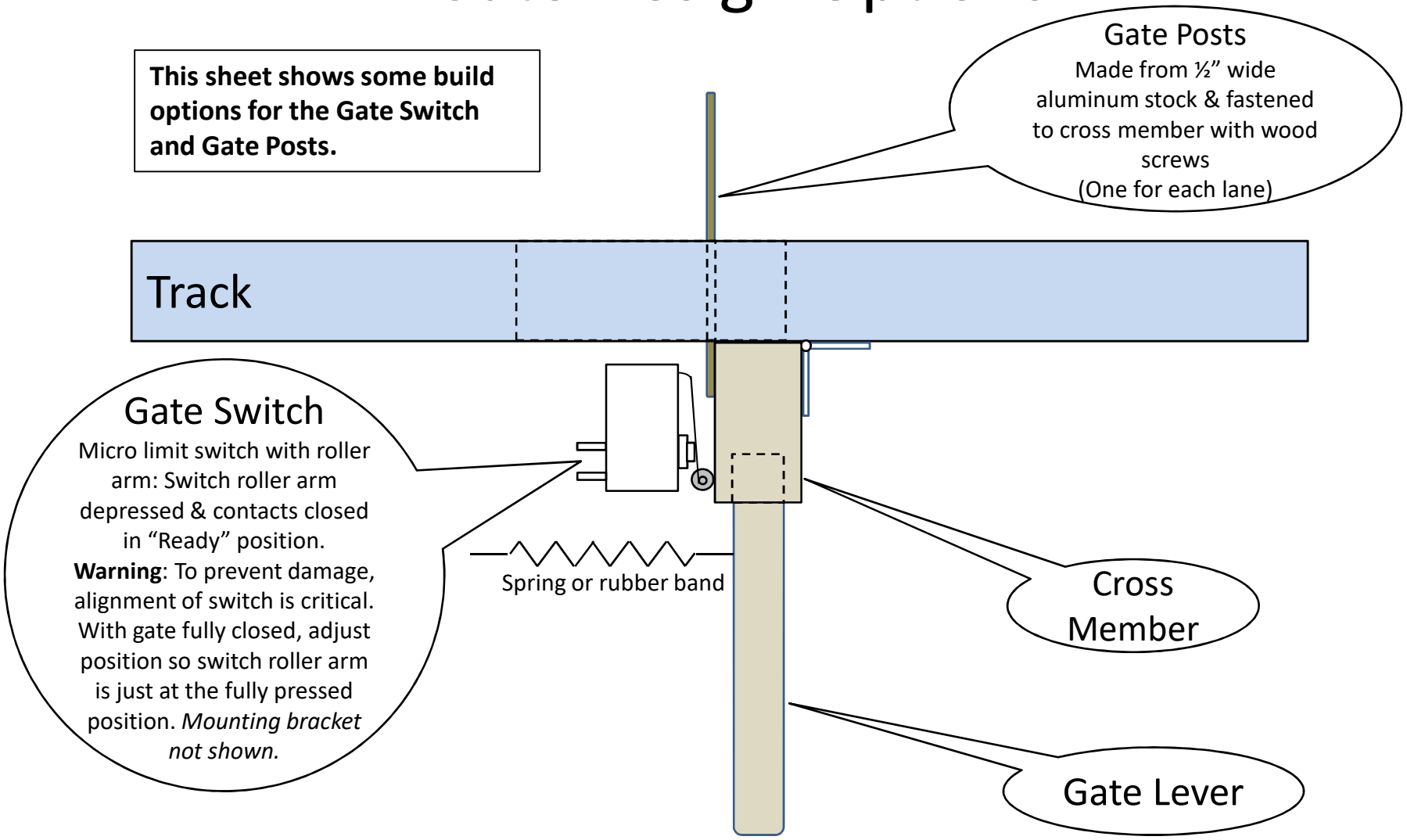
Gate Start Switch & Bracket Mounting



Reference http://www.rahul.net/mcgrew/derby/track/ for additional guidance & tips on track and start gate construction.

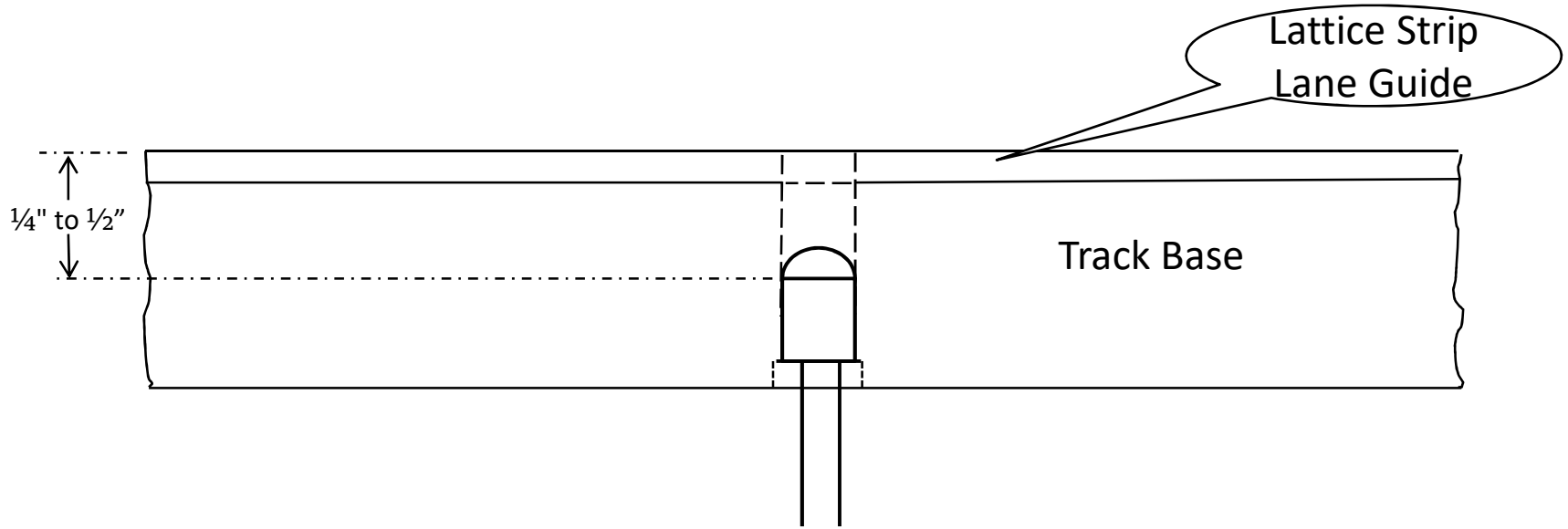
Gate Design Options

This sheet shows some build options for the Gate Switch and Gate Posts.



Reference http://www.rahul.net/mcgrew/derby/track/ for additional guidance & tips on track and start gate construction.

IR Lane Sensor Installation

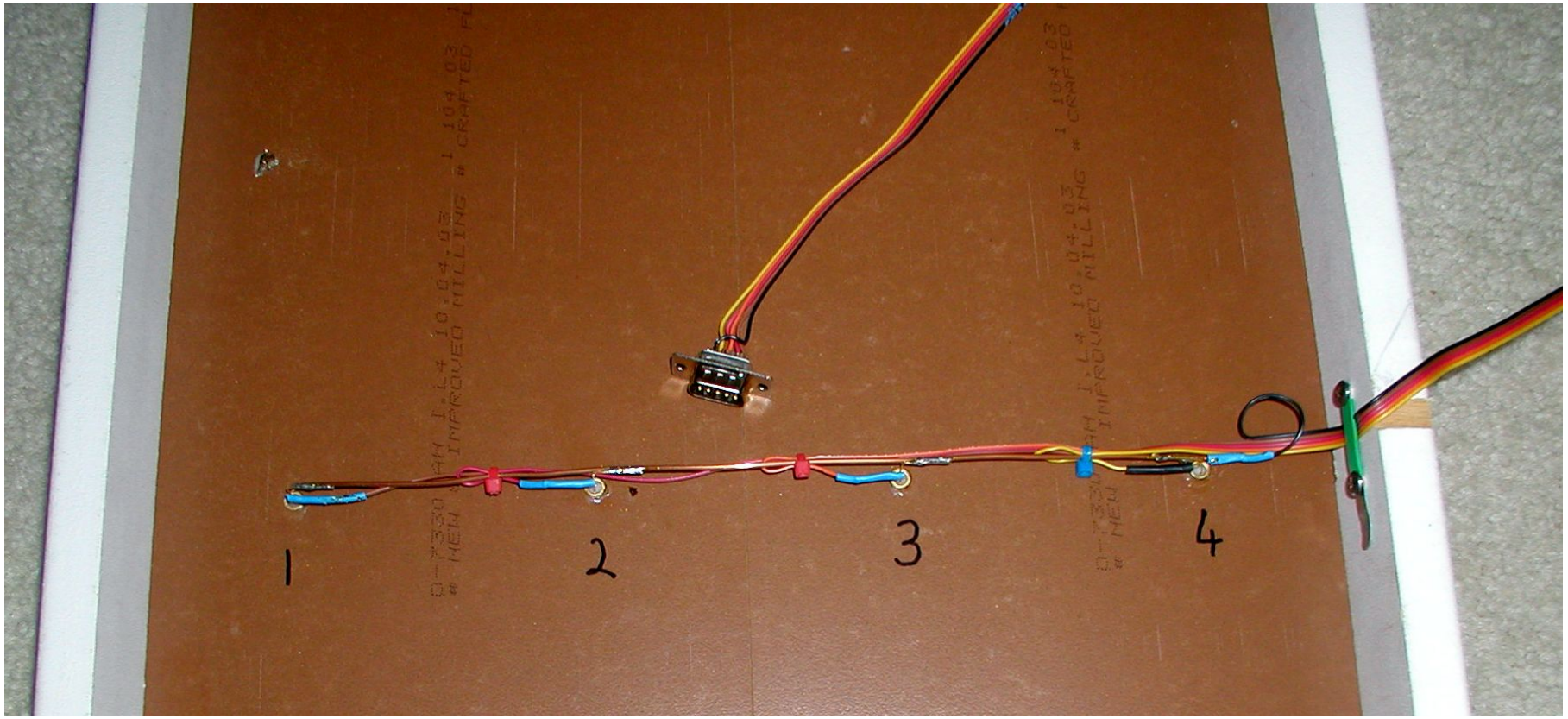


Holes having the same diameter as the IR sensors are drilled at the finish line of each lane. A slightly larger countersink hole may need to be drilled part way from the bottom so that the lane sensor can be inserted to achieve the proper depth where the sensor lens is about ¼ to ½ inches below the top surface of the track. They can be held in place using white glue or a hot glue applied to the base (bottom) of the sensor. Do not get any glue on the lens.

Mounting the sensor below the track surface prevents ambient light from other sources (directions) from illuminating the sensor thus making it more responsive to the light source directly overhead.

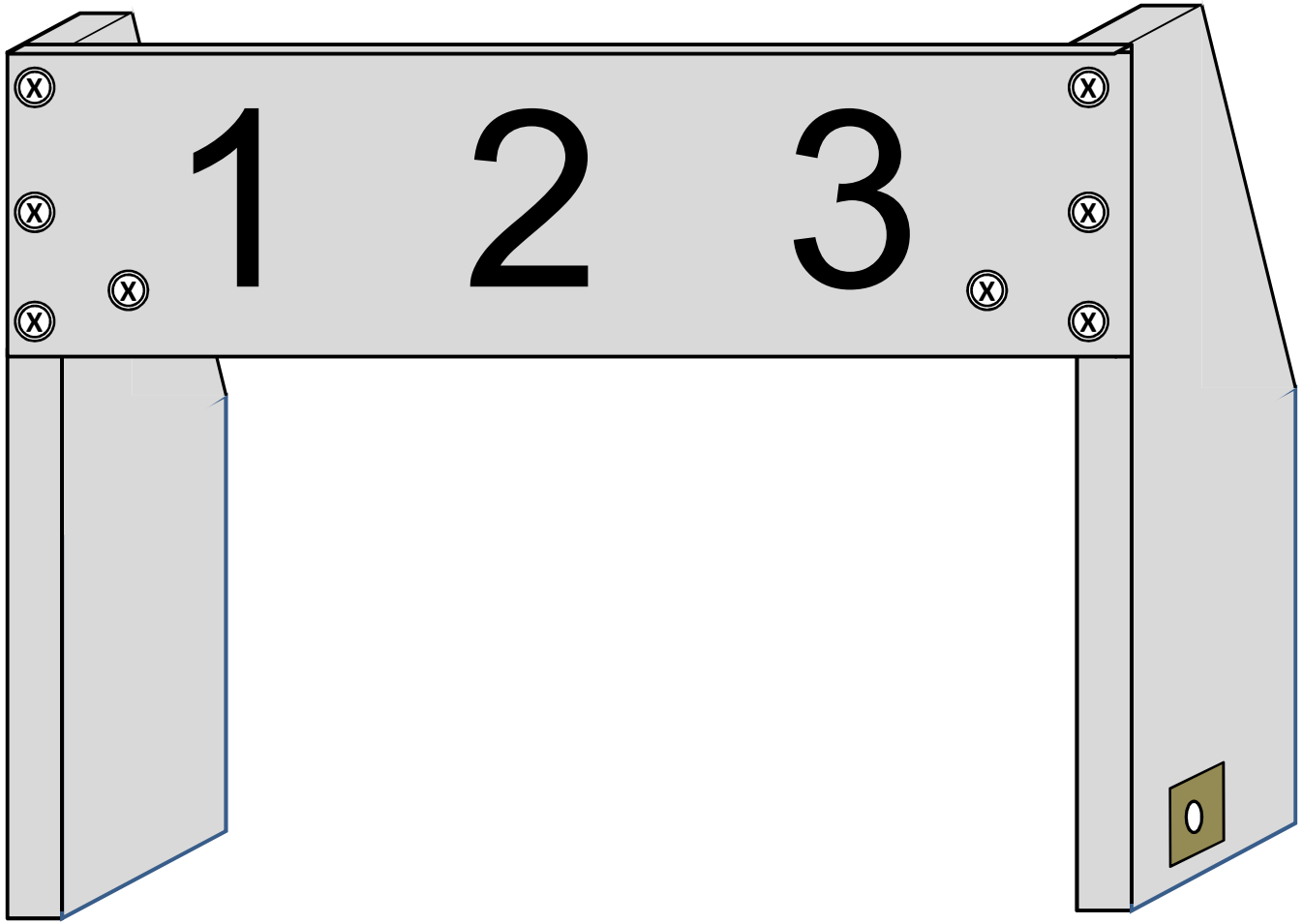
IR Lane Sensor Installation

In this particular installation the thickness of the material used for the track did not require a countersink hole to mount the sensor at the appropriate depth. A stiff piece of 14AWG copper wire was used for the common lead (soldered to the Emitter of each sensor) along with some zip ties to help hold the wiring in place.



3-Lane IR LED Light Bridge

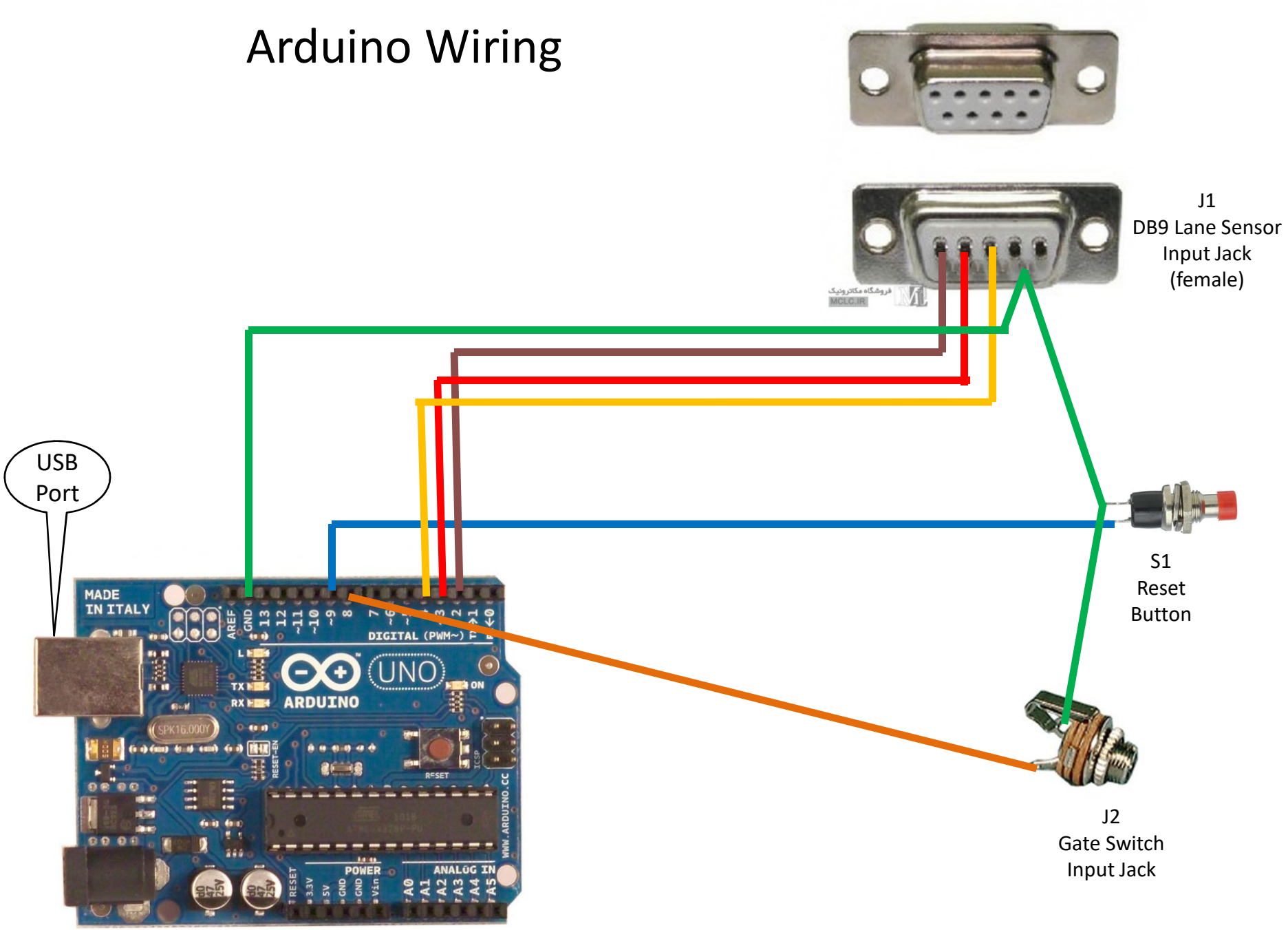
Download free plans to build this 3-Lane IR LED Light Bridge at
http://BillvsDerbyTimers.weebly.com



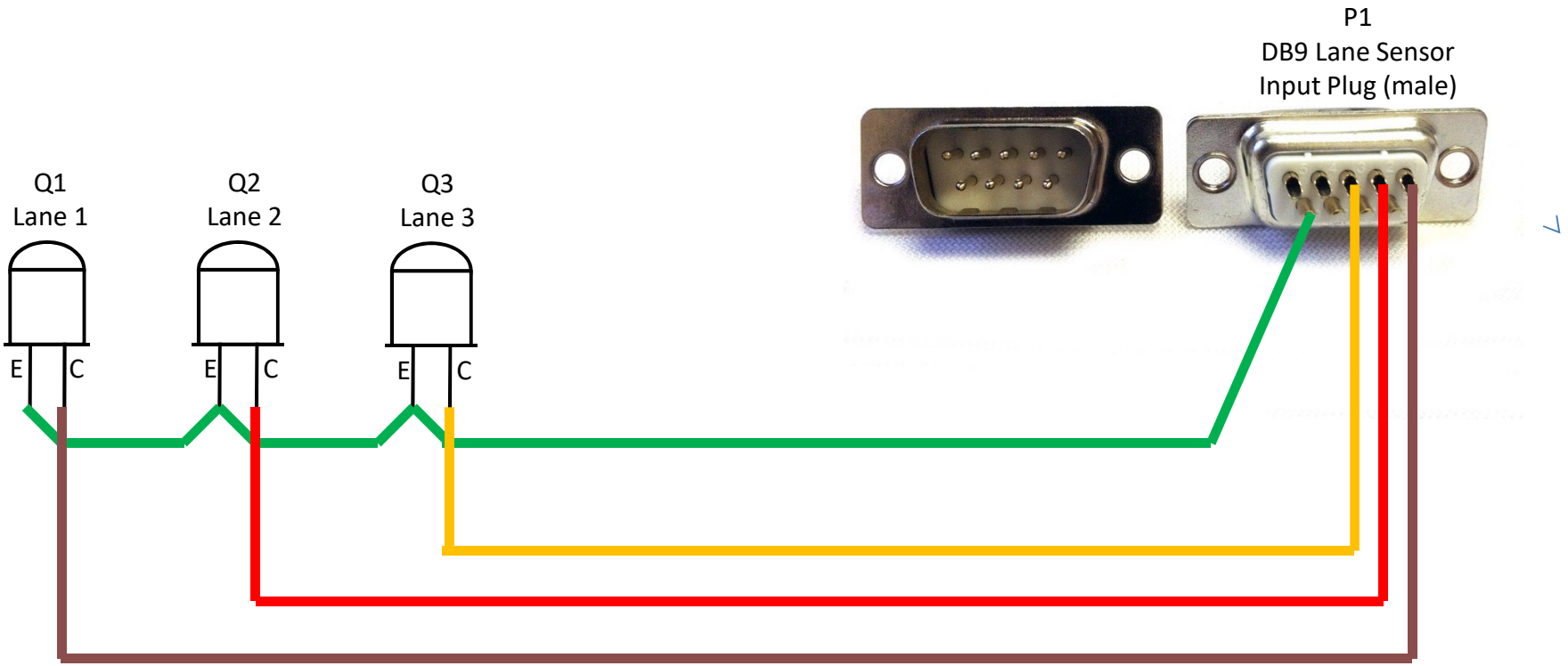
- - - Wiring Sketch - - -

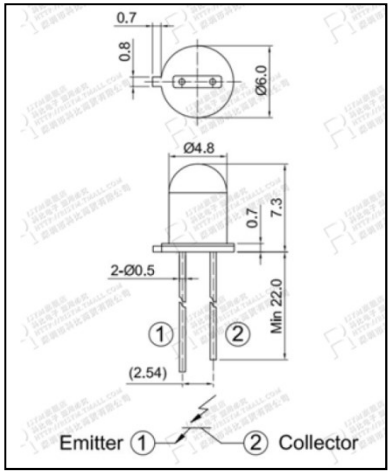
For the novice/beginner in circuit wiring

Arduino Wiring



Lane Sensor Wiring





Gate Switch Wiring