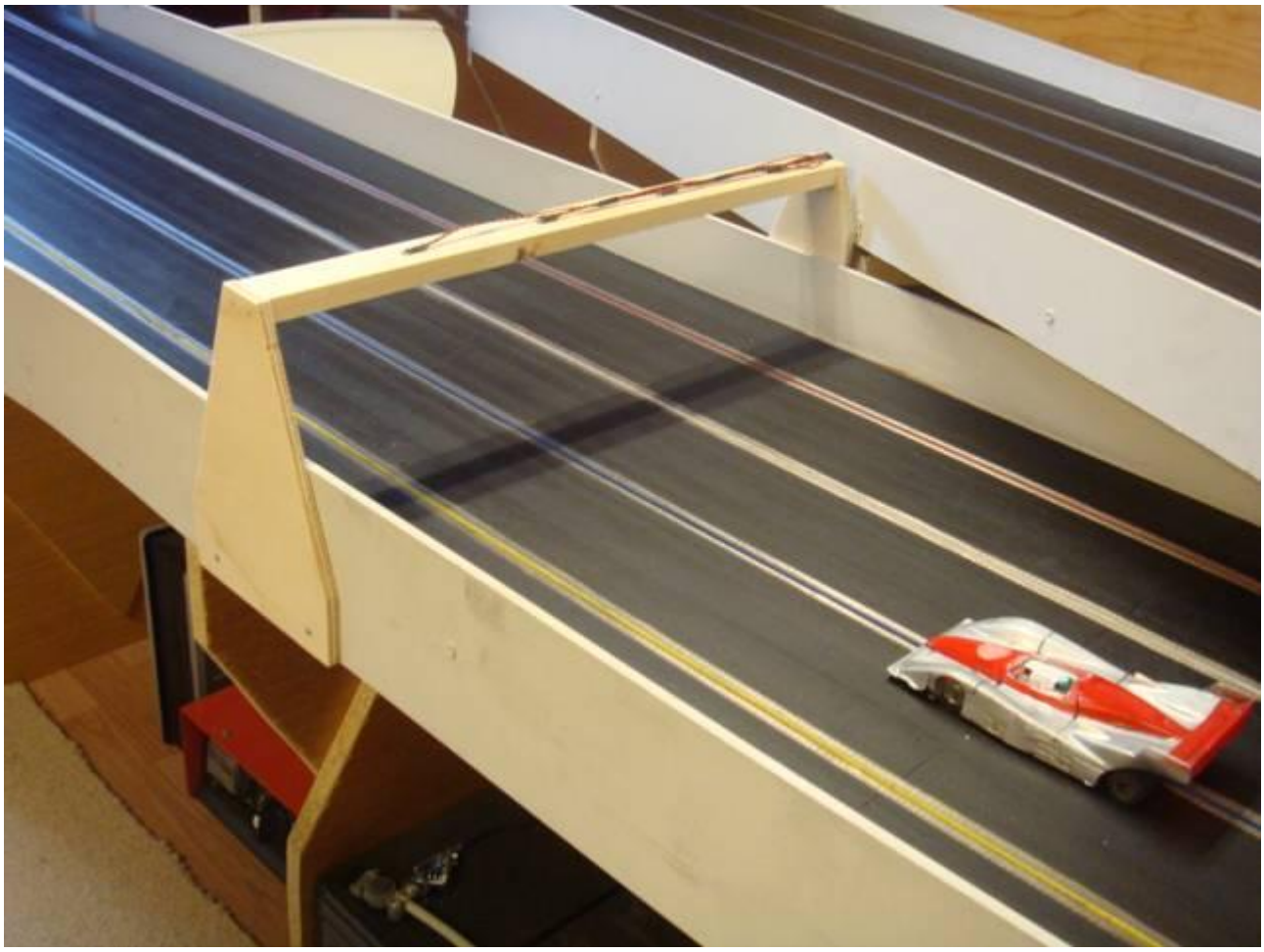
IR-Sensors for LapMaster.

Introduction



IR-Sensor Bridge installed at the LapMaster test track.

LapMaster was originally designed to use “Deadstrip” technology for track sensors. However it is also possible to use IR-sensors (Optical infra-red sensors) by connecting the LapMaster IR-Sensor system. However this system requires the user to build an overhead “Light-bridge” on the track.
As with most other things, an IR-sensor bridge needs to be build correctly in order for it so function flawlessly. This guide is written to help you do that.

The IR sensors consist of a light source (The bottom “smoke” colour LED in the picture), which emits IR (infra red) light, and an IR-sensor (clear colour LED), which changes conductivity when subjected to IR-light.
When a car passes between the two, the light beam is broken, and the change in conductivity of the IR-sensor is amplified in the IR-sensor board and this signal causes the LapMaster to count.

Positioning the IR-sensors

The fact that IR light is invisible to the human eye, makes it necessary to point out a few things that otherwise might be obvious.

First of all the light emitted from the LED's has a very narrow beam. The angle of the light spread from the ideal axis of the LED is as narrow as 20 degrees. That means that at a distance of 150 mm from the LED, the area exposed to light is a circle with a diameter of approx. 75 mm.
The amount of light detected by the sensor decreases very rapidly as the distance between the source and the sensor increase and this influences the sensors ability to correctly detect the passing cars. The LapMaster IR system has been designed to work with a distance between source and sensor of 100-150 mm. It is not recommended to exceed the maximum distance of 150 mm.

Sensors can be positioned either on the bottom or the top. We recommend putting the sensors in the overhead beam, and the light source at the track, for the following reasons:

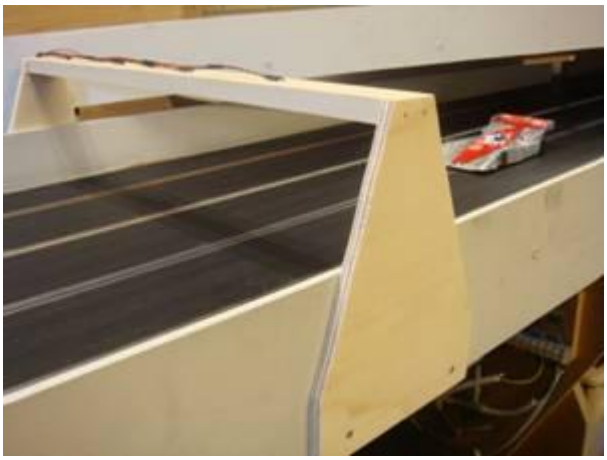
- When the sensors faces downward, very little "false" light can reach the sensor. You will have far less problem with overhead fluorescent light or direct sunlight influencing the sensors.
- Dirt accumulating on the track surface and track mounted LED's have less effect on the high power source, than on the low power sensors.

As for where to position the sensors on the track, the tradition has been to put it is the guide slot. However this is prone to collecting dirt and the narrow geometry of the slot can cause problems with correct alignment of the light beam.
Our recommendation is therefore to put it between the path of the tires and the guide braid. However if you intent to run F1 cars, you must make sure that they actual will break the light beam.
If you do decide to put them in the guide slot after all, then consider widening the slot a little at the sensor position to improve detection.

And last but not least, put the light bridge in a place where the cars do not fall off i.e. at the end of a straight is a good place. This will eliminate miscount due to cars crossing out of lane.

Mechanical construction

Please make a sturdy bridge with solid fixing to the track, so that vibration and the occasional hit by a stray car, does not bring your IR-sensors out of alignment.

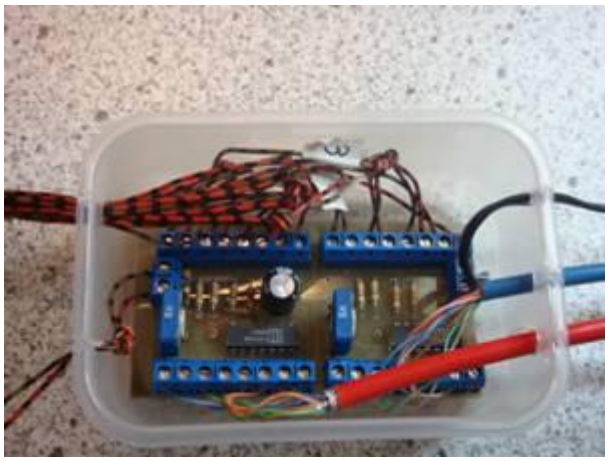


At the LapMaster track we started by drilling the 5 mm holes in the track surface.
We then continued to build a simple but sturdy light bridge out of a wooden beam (16x32mm) and two triangular pieces of plywood. In this particular case we have 130 mm from track surface to the lower edge of the Lightbridge.
We then drilled 5 mm wholes in the wooden beams in opposite positions of the holes in the track. It is important to have a good alignment here to maximize the amount of light coming from the emitters to reach the detectors.

Mount sensors in the bridge and light sources from the track underside. Even though a 5 mm whole makes a good tight fit with the LED's, you can use glue or duct tape to lock the LED's in place.

Wiring

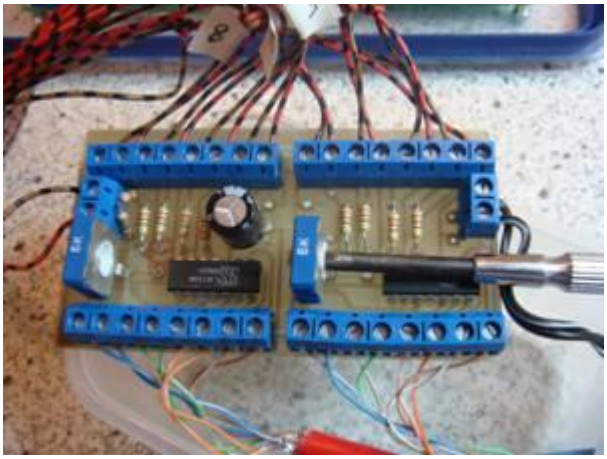
The wires from the sensors go to the IR-Detector box. This box also supply power to the emitting LED's, and have wires that connect to the LapMaster board, as well as its own power supply.

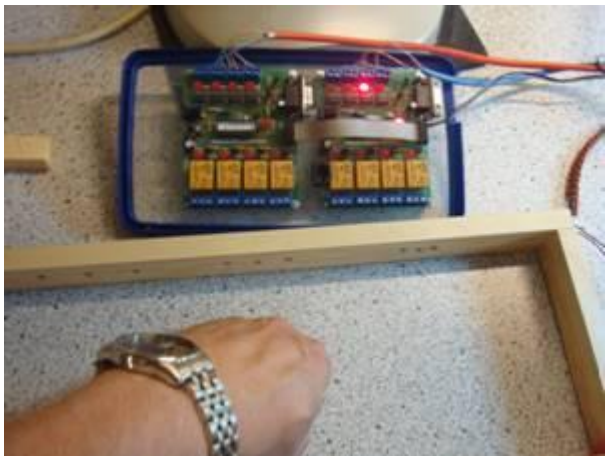


The IR-Detector box should be mounted close to the sensors. Do not extend the wires from the sensor to the box as this will increase electric noise and chance of false detections. However you are free to extend the wires from the detector box to the LapMaster for as long as you need. These wires can be extended using common LAN cables which are readily available everywhere. It is however not LAN, so you cannot use switch or routers. Nor should you plug it into your computer. It is only the cable and plug technology that has been re-used.

Calibration

As delivered the IR-Detector box has been calibrated. However if needed the board contains two trimmers which can be adjusted using a screwdriver. One is for lane 1 to 4, the other for lane 5 to 8. With this trimmer, the trigger point can be adjusted.





To trim you need to watch the input LED's on the LapMaster board.

Turn the trimmer clockwise until the LED's start to light up, and then turn it back until they all just turn off. This is the optimum trigger point.

Test it by obstructing the light beam, and you should see the associated input LED on LapMaster light up, indicating a count.

See the invisible

IR light is invisible to the naked eye. This makes it difficult to check mechanical alignment etc. when debugging a system. However if you use a digital camera, e.g. the one in your phone, you will be able to see the IR light, as the camera converts the IR light into the visible spectrum of white.

If you follow these guidelines, you will have a good and solid counting system.

Now have fun, Go race…

Carsten Grønnemann, LapMaster.