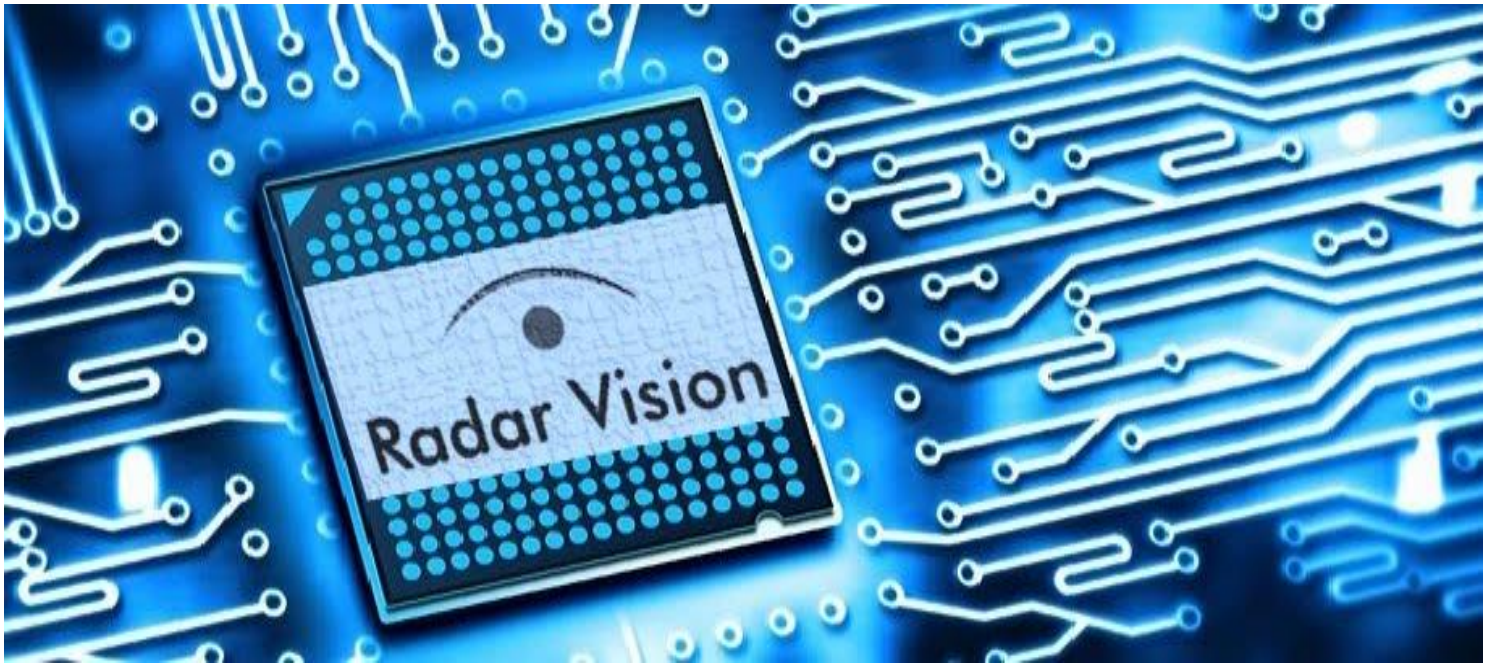


Radar Vision Pty Ltd

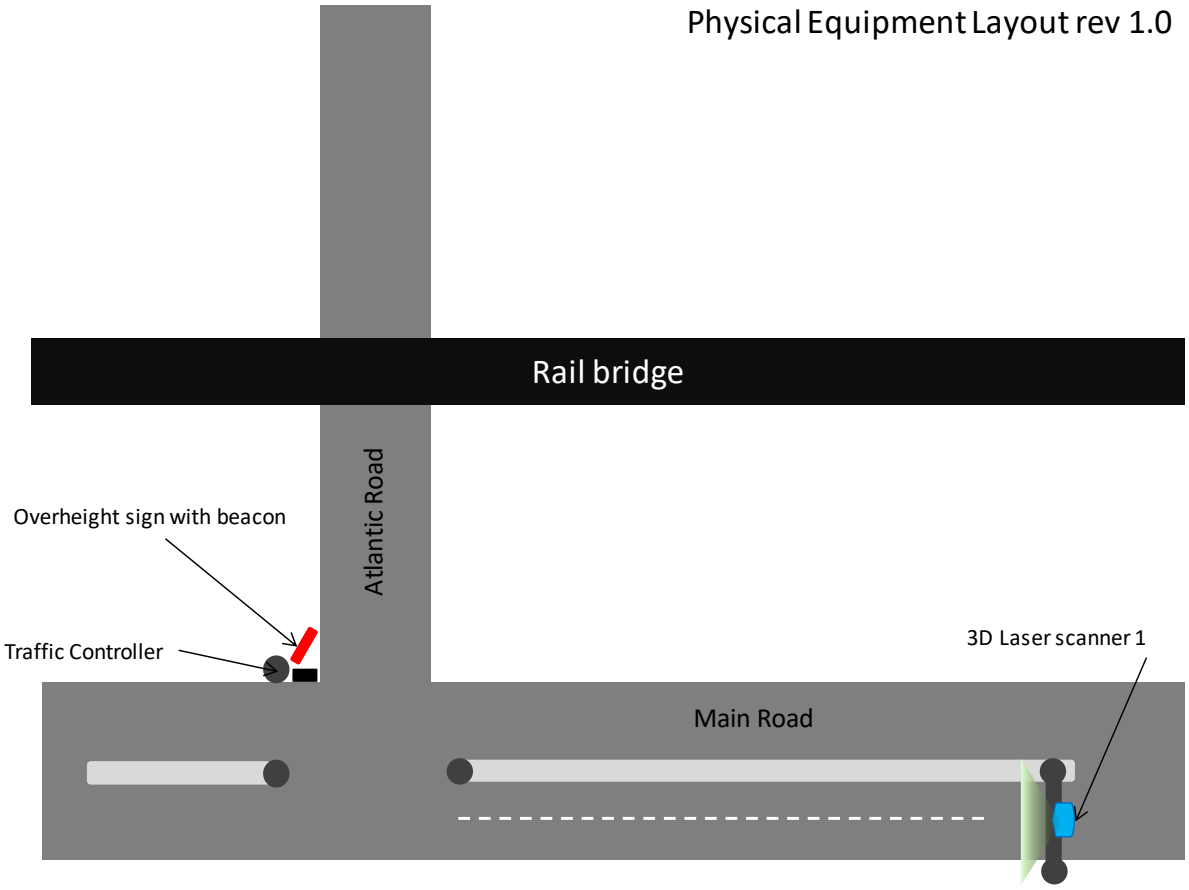
Over height detection and warning system

revision 1

Table of Contents

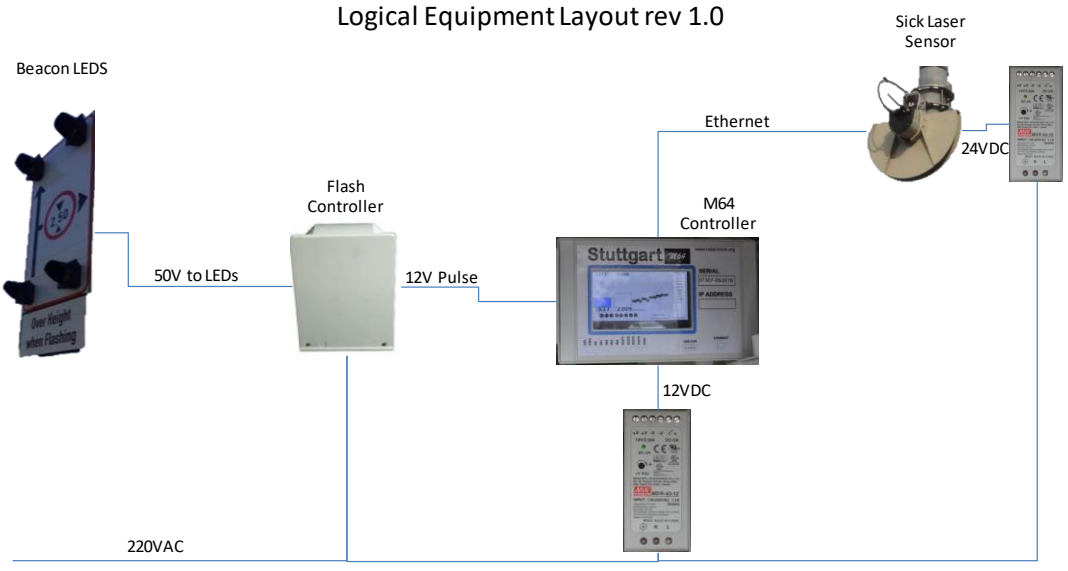
Site layout

The physical equipment layout shown below indicate the relative location of the traffic controller, laser scanner and sign beacon system.



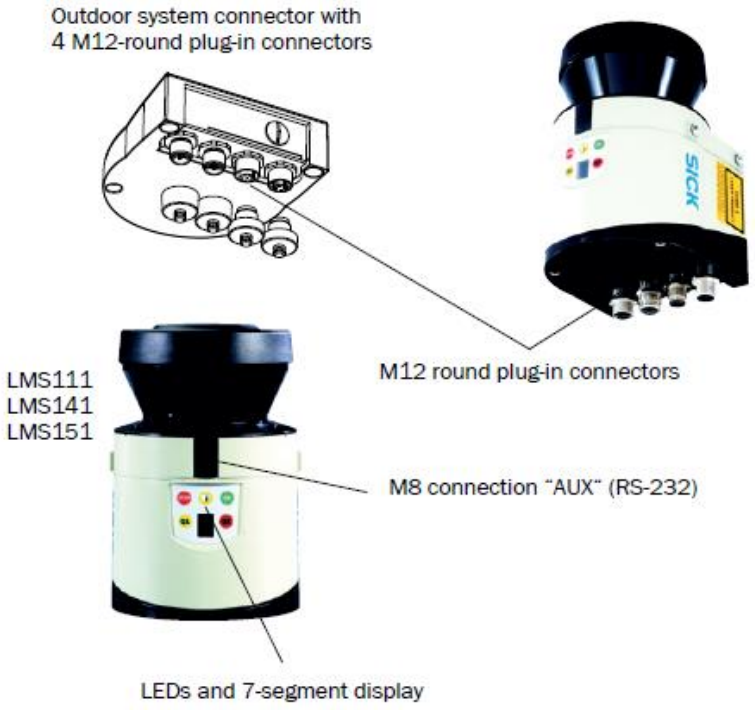
Hardware

The system consists of three subsystems, namely a SICK LMS1xx laser sensor, a Stuttgart M64 field controller and a LED flashing system as shown in the diagram below.

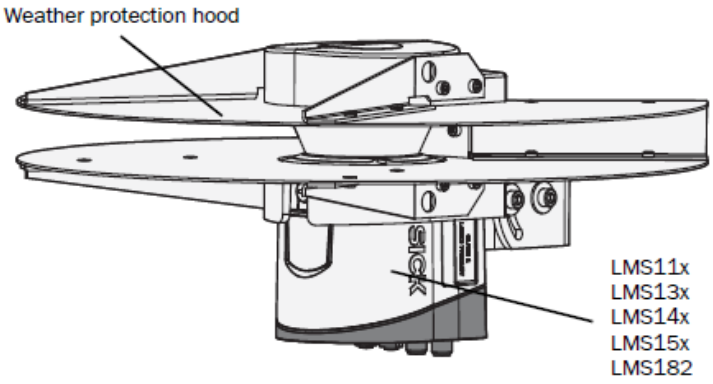


LMS1xx Laser Sensor

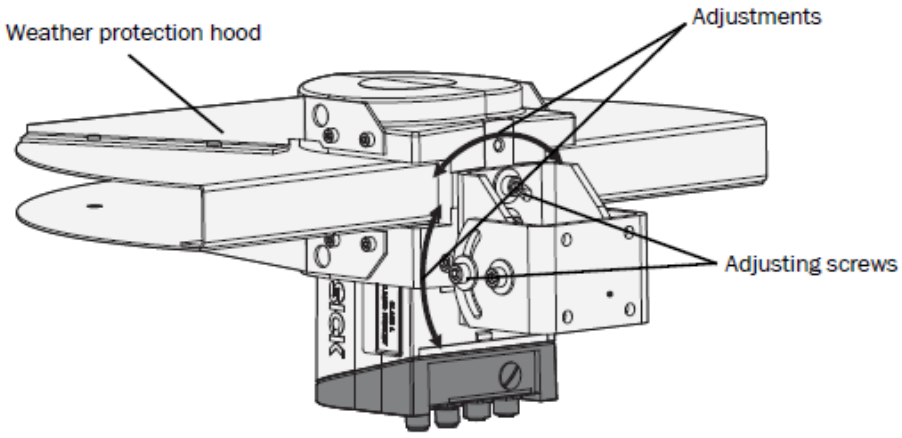
The laser sensor is bolted into a weather protection hood which is fastened to the overhead pole via a mounting bracket. See the illustrations below.



View of the LMS1xx laser sensor



190° weather protection hood with sensor inside



View of weather protection hood, sensor and mounting bracket with bolts

The sensor must be aligned vertically using a level in both axis. Realignment is only required when the sensor is replaced or moved.

The LED display on the sensor indicates the following:

Display	Possible cause	Rectification of the error
▯-▯, ▯-▯, ...	No error	Device in measurement mode
▯	IDLE mode, the outputs are in the OFF state, the laser is switched off.	No error. If the criteria for the IDLE mode are withdrawn, readiness for operation is re-established.
▯-	Motor starts	No error
E.	LMS faulty	➢ Send the LMS to the manufacturer for repair.

Stuttgart M64 Controller

The Stuttgart M64 is a 1GHz Arm processor running Debian Linux. The Stuttgart controller also has a resistive touch screen for sophisticated user interfaces. The operating system run on EMMC flash memory and the system is fitted with 32GB of additional storage for logging. The controller also offer a USB interface that support a keyboard. The command line can be accessed in Linux by pressing CTRL-ALT-F1…F5 on the keyboard. Those are terminal sessions. In order to go back to the graphical user interface, press CTRL-ALT-F7.

The system should recognise any USB keyboard immediately without installing device drivers.

The Stuttgart M64 has 4 optically isolated digital inputs. These inputs allow 3-30VDC as inputs.

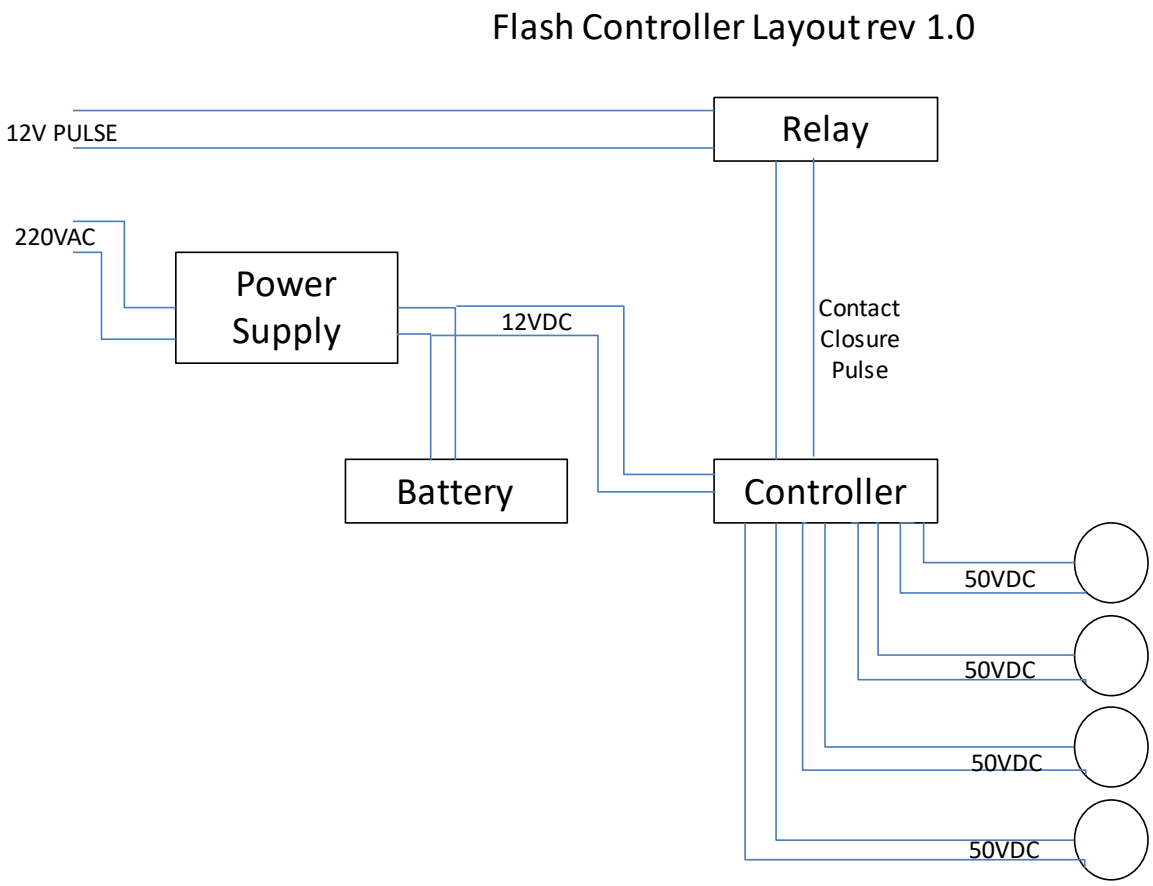
The digital outputs are solid state relays that are able to deliver up to 200mA each.

LED Flashing System

The LED flashing system has a microprocessor controlled power supply that boost the 12V power up to 50V for the LEDs into a capacitor bank. The controller also allows the capacitors to discharge into the LEDs to provide high power LED flashing. The LED flashing system is designed to prevent inadvertent flashing by only recognizing pulses of a certain with to trigger the flashing for a predetermined flashing period as indicated in the table below.

Function	Flash Period
Flash Off	0.5s pulse
Flash Bright	1.0s pulse
Flash Dim	1.5s pulse

The LED flashing system architecture is shown below:

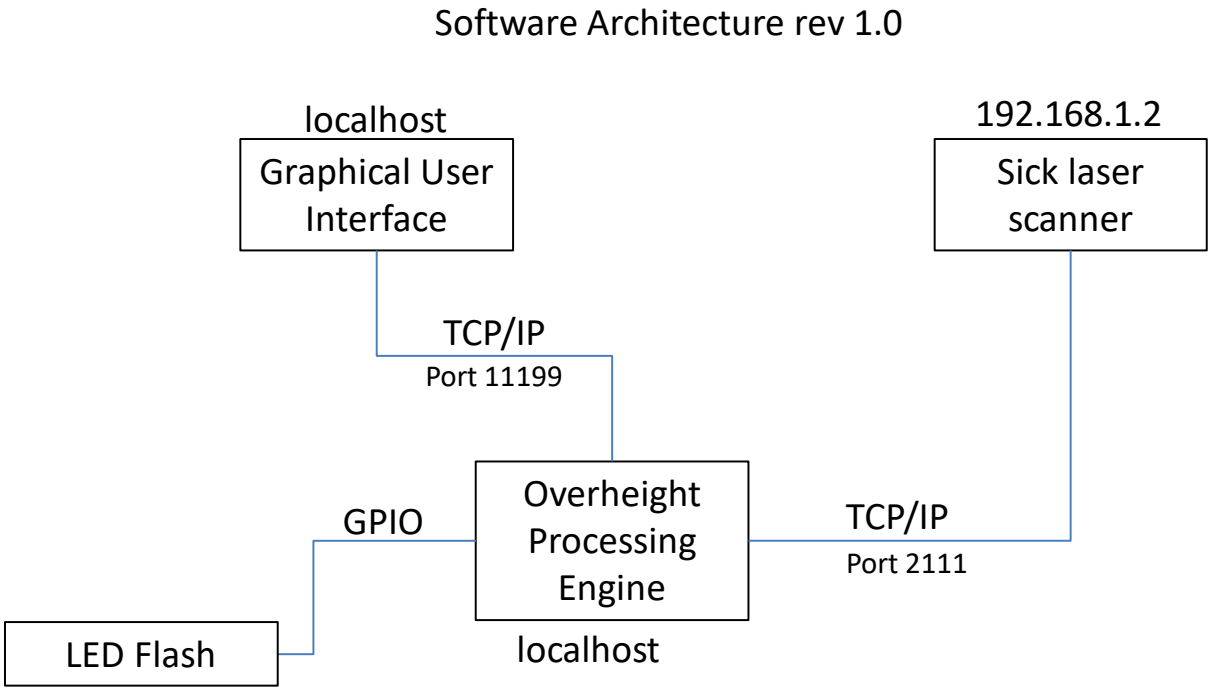


The triggering of the controller is a short circuit of the duration in the table below at the trigger terminals. The 12V pulse from the Stuttgart controller is converted to a trigger short circuit through a 12V relay

Due to the 5-10A inrush current required to charge up the capacitors, the system requires a battery which also serve as a backup power supply. Thus, one should never run the system on the power supply alone with battery disconnected.

Software Systems

Architecture



The software runs on Debian Linux. There is no root password configured, so logging in as root allows full access to the system. Basix Linux skills are required if you want to monitor or maintain the operating system.

/etc/network/interfaces contains the IP configuration

/home/debian/ is the home folder and the location of the executables

The Graphical user interface was built on Lazarus

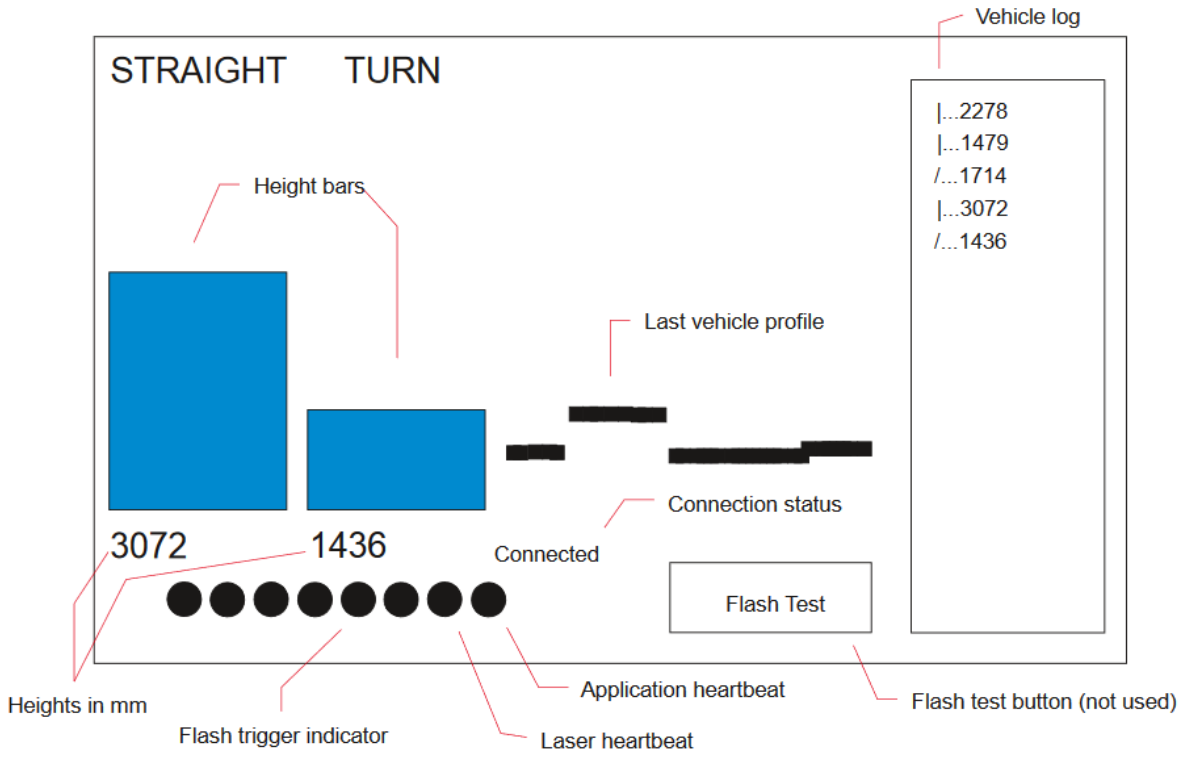
The processing engine contains C++ code compiled with GCC for ARM

Overheight processing engine

The Overheight processing engine is started automatically on startup. It communincates with the laser unit via Ethernet and with the Flash unit via digital output. It analyses every vehicle by measuring the horizontal (transversal) profile around 20 times per second. Those slices of measurement are used to determine one vehicle from the next and also the vehicle profile displayed on the graphical user interface (GUI).

Graphical User Interface

The user interface is display on the Stuttgart controller's screen and look as follows.



The heights are shown for the left lane on the left and the right lane on the right. The height is also shown graphically on the Height bars in real-time.

The inputs and outputs are shown below as lights. Black means off, and yellow means on. The left 4 are the 4 inputs and the right 4 are the 4 outputs on the Stuttgart unit. The position left to right corresponds with the position left to right on the physical green Phoenix connector where the inputs and outputs are connected to.

The connected status shown is an indication whether the Graphical User Interface is connected to the height processing engine. If it says "connecting" then the processing engine is not operating and the system may need to be restarted. Someone knowledgeable with Linux may be able to only restart the processing engine if an error occurred with it. If it says "connected" it is also an indication that it regularly gets messages from the processing engine. It does not however indicate whether the processing engine is able to communicate with the laser unit or the flash unit.

The last vehicle profile shows the height profile that was measured for the previous vehicle. It must be noted that the Y-axis represents height for the turning lane only, but the X-axis represents time. Therefore, faster vehicle appears shorter.

The vehicle log shows the highest point in each vehicle in mm and the lane the vehicle is in. A"|" represents the left or straight lane and a "/" indicates a right turn or right lane.

Communications to the flash unit is one directional. The Flash unit status can therefore not be read.

Start-up process

To start the system, switch on the power supply of the Stuttgart controller. The controller should boot up and the GUI should automatically start up. It should take about 30 seconds before the application is ready to detect vehicles.

Running checks

Ensure that the laser and application heartbeat dots are flashing yellow every five seconds. If they flash, the laser and application is running normally. Also ensure that the height bars and numbers on the GUI are being updated. This indicates that the system is detecting vehicles.

Configuration file

The system configuration is stored in a file named config.txt. It resides in the same directory as the application binary. The following is a list of all the system settings specified in the config.txt file.

- IP address of the laser sensor (LASER_IP_ADDRESS)
- IP address of the optional camera (CAMERA_IP_ADDRESS)
- Horizontal measuring start position in mm (HORIZONTAL_MIN)
- Horizontal measuring end position in mm (HORIZONTAL_MAX)
- Starting position of the first lane in mm (START_OF_LANE_A)
- First lane width in mm (LANE_A_WIDTH)
- Second lane width in mm (LANE_B_WIDTH)
- Height of the sensor above the road surface in mm (SENSOR_HEIGHT)
- Horizontal position of the sensor relative to the measuring start position, in mm (SENSOR_HORIZONTAL_POSITION)
- Minimum height for detecting objects in mm (MIN_DETECT_HEIGHT)
- Maximum height for detecting objects in mm (MAX_DETECT_HEIGHT)
- Minimum object width for detection in mm (MIN_OBJECT_WIDTH)
- Minimum number of samples for detection of objects (MIN_DETECT_COUNT)
- Overheight threshold in mm above the road surface (OVERHEIGHT_THRESHOLD)

Changing the configuration

To change the configuration, open the config.txt file. Below is an example of the typical contents of the file.

```
LASER_IP_ADDRESS,192.168.1.2
CAMERA_IP_ADDRESS,192.168.10.2
HORIZONTAL_MIN,0
HORIZONTAL_MAX,7500
START_OF_LANE_A,500
LANE_A_WIDTH,3250
LANE_B_WIDTH,3250
SENSOR_HEIGHT,6600
SENSOR_HORIZONTAL_POSITION,4000
MIN_DETECT_HEIGHT,500
MAX_DETECT_HEIGHT,5000
MIN_OBJECT_WIDTH,200
MIN_DETECT_COUNT,3
OVERHEIGHT_THRESHOLD,2500
```

Edit only the values that you want to change. Do not remove any of the commas and do not change the field names before the commas. Change only the values after the commas.

Note: Changing the file format may make the file unusable.

Maintenance

Laser

The LMS1xx laser sensor is largely maintenance-free. However, the following routine maintenance must be performed on the laser sensor:

- Ensuring that the mounting bolts are fastened
- Cleaning the optics cover

Due to the laser sensor being operated in a windy and coastal area, the mounting bolts must be checked periodically. Ensure that they are fastened properly and that the sensor is firmly in position on the overhead pole.

Cleaning the optics cover

The optics cover on the laser sensor should be cleaned regularly and if it is contaminated. Do not use any aggressive detergents or abrasive cleaning agents.

Static charges can cause dust particles to be attracted to the optics cover. You can diminish this effect by using the anti-static plastic cleaner (SICK part no. 5600006) and the SICK lens cloth (part no. 4003353).

How to clean the optics cover:

1. Remove the sensor from the weather hood by loosening the bolts attaching it.
2. Use a clean and soft brush to remove dust from the optics cover.
3. Wipe the view window of the optics cover with a clean and damp cloth.
4. Place the sensor back into the weather hood and fasten the bolts.

LED flash system

The battery voltage must be checked once every 2 years by switching off the circuit breaker and measuring the battery voltage. If the battery voltage is below 12.5 volt the battery must be replaced. The LEDs can be checked every 5-10 years for light output using a photographic flash light meter to determine if there are deterioration of the LED units light output.

Stuttgart M64

The Stuttgart M64 drive space can be checked once a year to determine if there is still enough space left for the operating system. Any space more than 100MB should be sufficient. Use the df command on command line to look at drive space left.

Troubleshooting

Stuttgart controller not powering up

a. Check if 12V is supplied using a multimeter measuring over the 12V input terminals. If 12V is present and the LCD does not show anything within 60s after powerup the unit is faulty and must be replaced.

Laser not running

a. If the laser is not communicating first check to see if you can ping the laser from the command line. If you cannot ping the laser follow further steps:
b. Open up the service panel on the pole that the laser is mounted on. Measure if 12v is present.
c. Look at the laser unit if the 7 segment display is on.
d. Plug in laptop directly to the laser unit sevice panel by using the existing barrel connector. Now ping the laser from the laptop being configured as fixed IP address. Note that the Stuttgart may not be able to recover automatically if you unplug the Ethernet port from it. You may have to either cycle power or use the commands ifdown and ifup to bring Eth0 up again.
e. You can use nc (netcat) to connect to the laser to dermine if it is operational.
f. You can also use arp-scan --interface=eth0 –localnet to determine if the laser IP settings are misconfigured

User interface not running

a. Restart Stuttgart
b. If the user interface is not coming up, the filesystem may have an error
c. If the user interface comes up, but it is not connecting to the overheight processor application, it may because of incorrect port settings. Use netcat to create a localhost listener on the port indicated in this manual.

User interface and laser running, but no vehicles detected

a. If no vehicles are detected it means either the configuration settings are incorrect or the laser lens is dirty

LEDs not flashing when triggered

a. You can use the command ./bin/flashbright to generate a flash pulse
b. First determine with a multimeter if the 1 second pulse is generated on the Output 1.
c. Measure or observe that the relay is switched for a second inside the Flash controller box.
d. Use a multimeter to measure the voltage on the secondary side of the relay. It should show a voltage 3.3V ro 0V change when it switches.
e. You can also manually trigger the flash by shorting out the pins for exactly a second. This may take more than once of trying to get the right timing. The flash will flash for 30 seconds.

NOTES

NOTES

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