GTE Industrieelektronik

ALBERO

GEFÖRDERT VOM
Bundesministerium
für Bildung
und Forschung

Funding Code 13N14685

Milestone Component

4.4 „Adaption of fire detection technology“

GTE contribution / as of 17th February, 2020

Objective

In order to provide a fire message with increased reliability, both a linking evaluation of various measurement or detection variables and a description of the resulting statements are required. Possible messages include:

type of message	**addressee of message**	**action**
vehicle overgeating	personnel	control round if necessary: provide partition wall
fire on electric vehicle	BMA and personnel	water spray extinguishing system
gas leakage	management and personel	ventilation system
fire on gas vehicle	BMA and personnel	water spray extinguishing system

table 3: possible outputs of the demonstrator incl. reasonable actions

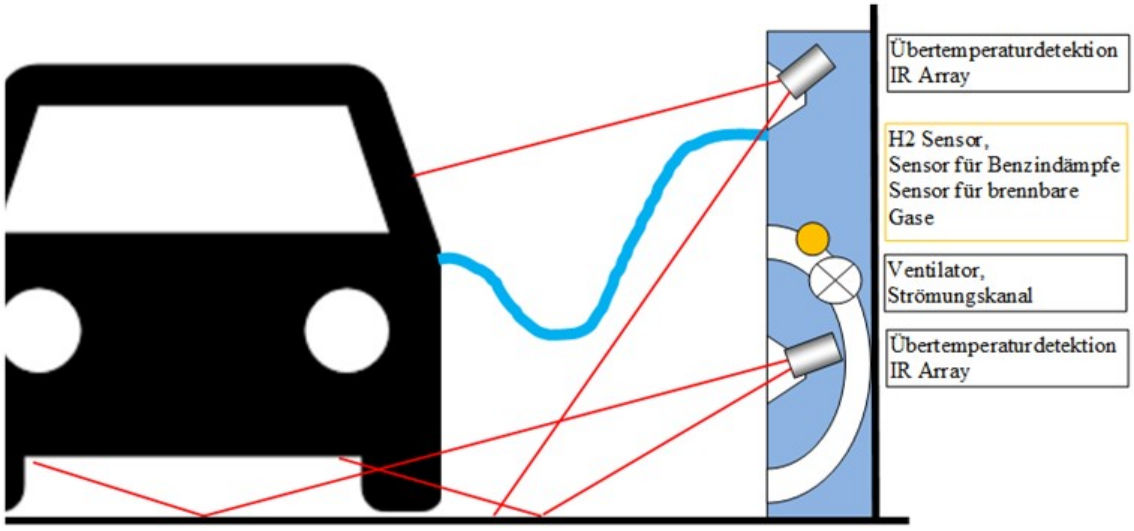
Different switching outputs for the various messages are planned for the demonstrator. Thus, the demonstrator can be adapted to any BMA at least via BMA specific interface modules.

Possible variants of the demonstrator:

Variant 1:

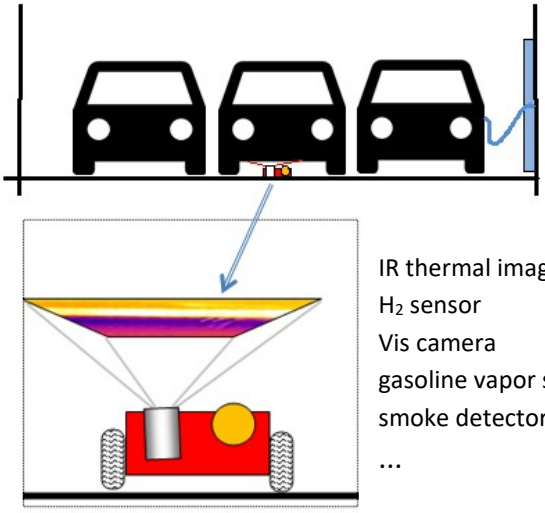
detection system

- near a charging possibility
- assigned to each parking space that is to be monitored

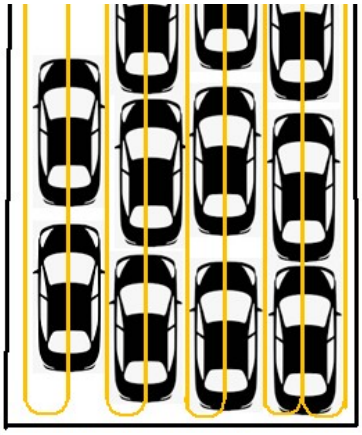


Variant 2:

area-wide monitoring of side and underside of vehicles,
detection of H_2 release
on the platform of an autonomous driving drone



IR thermal image
H_2 sensor
Vis camera
gasoline vapor sensor
smoke detector
...

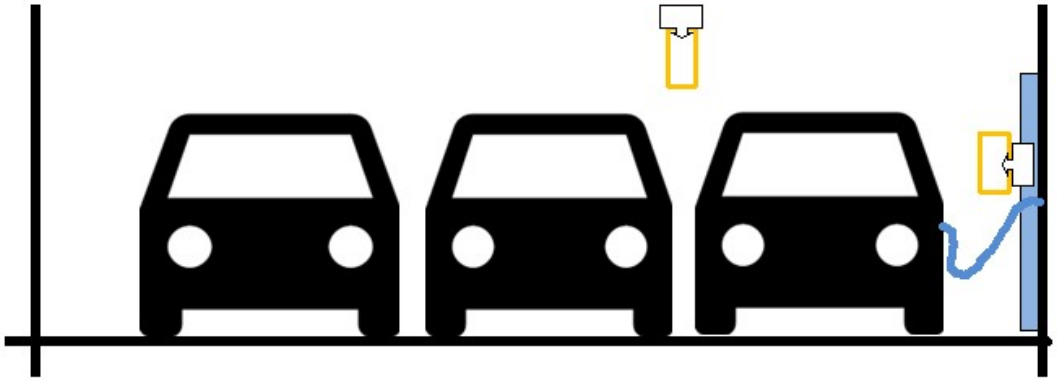


driving route is oriented to colored markings on the ground

Variant 3:

area-wide monitoring
- sideways?
- from above?

sensors are installed on rails, for example, and the sensor module regularly scans the length of the vehicle deck.



The characteristics of each variant, advantages and disadvantages are listed in the following table.

The project partners were asked which variant was preferred. The results can be found in the second part of the table.

variant	1	2	3
location / type	**fixed in position for each parking space to be monitored**	**driving drone, on virtual meanders**	**sensors on rails or ropes**
quantity needed	At every parking space: - each charging station - each additional "critical" parking space	one per deck plus control center (charging station for drone + evaluation)	one per vehicle lane
coverage	„few m^2“, i.e. one vehicle per detector	„area-wide“ – monitors each vehicle under which the detector passes by	„area-wide“

response speed	„fast“	„delayed“ by the duration of one cycle (example: 200 m distance with 0,5 m/s --> 7 Min.) If faster detection is required (useful!), the number of vehicles to be scanned must be reduced or the number of detectors must be increased.	„delayed“ by the duration of one cycle (example: 100 m distance with 0,5 m/s --> 3,5 Min.)
detection target	monitoring at the parking space E-cars: thermal runaway other APV: leakage and gases, immediately adjacent gases	monitoring of all vehicles; focus areas: thermal runaway of E-cars, leakages in a liquid state, Leakages of gas, heavier gases	monitoring of all vehicles; focus areas: thermal runaway of E-cars (low sensitivity), Leakages in a liquid state (low sensitivity) Leakage gas, lighter gases
parking space concept	yes, required only for permanently assigned parking spaces	no without permanently assigned parking spaces; but more efficient (faster detection) if it is known which types of vehicles at what location	restricted, without permanently assigned parking spaces within a lane
local resolution	yes, since detection is assigned to a parking space	yes; but only parking spaces that are approached	yes; but only parking spaces that are approached
sensitivity	E-cars for battery fires: optimal detection other APV: suitable for gas, and also flame detection	Optimal for battery fires and liquid leaks; too slow for gas leaks and conventional fires	medium sensitivity for leakage and gases low sensitivity thermal runaway
action on release	if charging station: switch off message to staff	message to staff	without permanently assigned parking spaces
service request	„low“ (1 / year)	„frequently“ (1/week [?])	„seldom“ (1/month [?])
EX (Zone 1) area suitable	"yes" place gas sensors higher than 45 cm, IR sensor intrinsically	rather "no"; possibly very expensive; (if necessary, costs additionally x 2)	not required, as above the vehicles

	safe, can also be lower than 45 cm		
costs (estimate)	< 10 k€ per position	> 100 k€ per deck	> 100 k€ per deck
sensors	2 x IR thermal image, 1x H_2 gas sensor 1x gasoline vapor gas sensor 1x "combustible gases" sensor	1 x IR thermal image, 1x H_2 gas sensor 1 x Sensor "gasoline“ other sensors Sensors for localization - ultrasound - barcode reader radio (WLAN, "other"?) battery-powered	1 x IR thermal image, 1x H_2 gas sensor 1 x Sensor "gasoline“ other sensors Sensors for localization - ultrasound radio (WLAN, "other"?) battery-powered

v**ariant**	1	2	3
location / type	**fixed in position for each parking space to be monitored**	**driving drone, on virtual meanders**	**sensors on rails or ropes**
GTE: preference (1, 2, 3)	2, but to be realized first (project plan!)	1	3
GTE: reason for preference	Has the highest sensitivity, robustness and can be implemented in a manageable time.	From the point of view of the research project the more interesting variant for a technology demonstrator, it is still a long way to realization, but the most versatile variant.	Has the worst sensitivity and is realizable with effort time; but robust.
HBRS preference (1, 2, 3)	1	2	3
HBRS: reason for preference	Should only be provided for E-cars, other gas detections should be made possible by RAS, the consequence of increased ventilation in case of "gas alarm" does not need location resolution. E-cars will likely always require a parking concept (charging point in appropriate locations and not mobile). Also fits best to the project description ALBERO.	Probably not suitable for use on board and susceptible to interference, environmental conditions are very harsh. Autonomous driving is a big challenge with undefined footprints. Time for a scan of the ferry deck could be very long. Interesting actually only for e-cars, since the others can also be detected in this way.	Won´t be probably suitable for on-board use. Sensitivity for e-cars not given. Hanging sensors are sure to be broken quickly. RAS should be sufficient for gas-powered cars.
FKFS preference (1, 2, 3)	1	2	3
FKFS: reason for preference	Fast triggering Vehicle type related detection ABF oriented solution.	Interesting variant for complete monitoring of the deck, but many disturbance variables to be considered such as: Detection of vehicle type, lane not clear, influence by ambient conditions → Improved detection of all hazards (possibly worse for light gases).	poor sensitivity
FKIE preference (1, 2, 3)	3 if distributed throughout the deck	1 (independent of feasibility due to Ex-protection)	2 (independent of feasibility due to Ex-protection)

FKIE **reason for preference**	From our point of view it looks like this: If a shipping company decides in favor of the fixed sensors in order to be able to safely transport the risk vehicles classified by the shipping company even on a closed deck, it should attach as many monitoring stations as possible so that it is possible to place the vehicles flexibly and they do not have to be assigned to one location (possibly expensive). But if the shipping company decides for only a few places, these places will be marked accordingly in our tool and allocated preferentially to the vehicle category to be monitored. As I understand this concept, it would mean that the sensors can only be installed where there are structural devices. (outside lanes or if stairs are inside - also inside lanes) This would also limit the maximum number of monitoring stations.	In principle, this is the most interesting solution for FKIE, since this does not represent any further constraints in our system.	This is the second most interesting solution for FKIE. It also offers flexibility in placement, depending on the number of rails chosen. Just like scenario 1, the shipping company can decide not to equip all tracks with rails/ropes. Then it is noted in our tool and the vehicles to be monitored are preferably placed here. If every track is equipped, this solution is as interesting as scenario 2, because it allows a flexible placement.

Demonstrator 1.0

The concept of the demonstrator for monitoring a single vehicle was developed, that takes into account the indications and wishes of the partners.

Individual sensory components are available:

- IR Sensoric Array

- H_2 Gas Sensor

Further sensors, which are used e.g. for leakage detection and are considered by the partner HBRS, can be included.

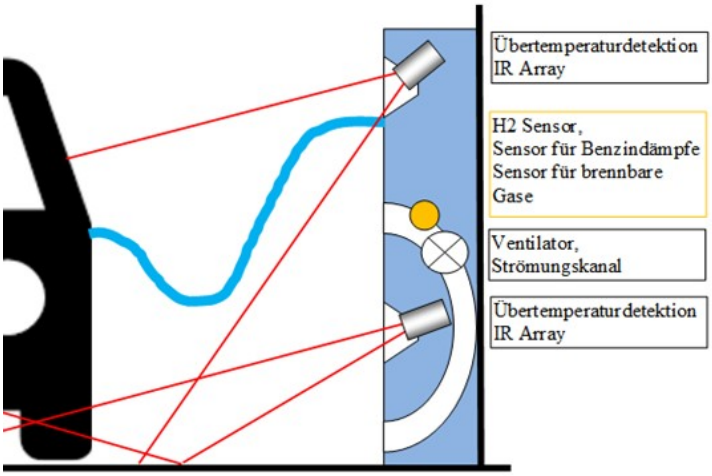


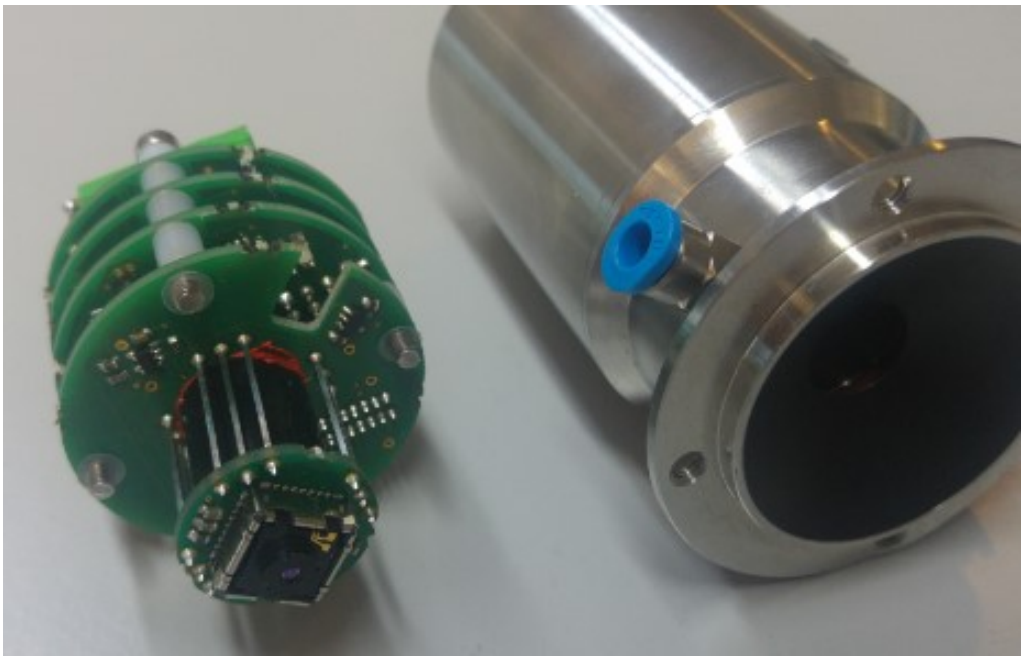
Figure 9: sketch of the demonstrator according to the concept for monitoring a vehicle

IR Sensor inside Demonstrator 1.0

- intrinsically safe design (suitable for EX-Zone 1)

- resolution 32x32 pixels, upgradeable to 60x80 pixels

- Response time at least 100 ms



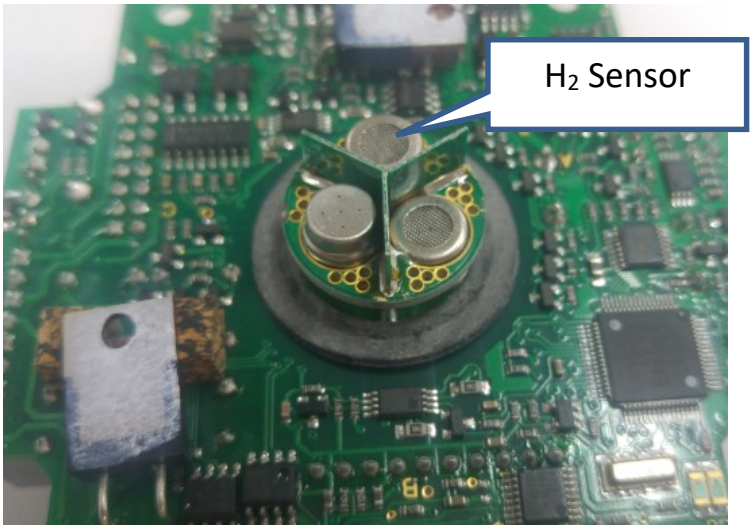
Gas Sensor inside Demonstrator 1.0

semiconductor sensor of the company UST

- temperature cyclic operation

- detection range 0 to 100 ppm H_2

- response speed 30 sec



Demonstrator 1.0 – first version

This unit is available for the second half of the project for testing.

- → qualification
- → optimization
- → modification