



Valeo Innovation Challenge

Phase 1

To be uploaded as a .pdf document to the Valeo Innovation Challenge website before the submission deadline

Deadline: February, 14 2014; 8:00 pm CET

*Please read carefully the **Valeo Innovation Challenge Rules and the FAQ** before starting the description of your proposal. Bear in mind that the proposal will be evaluated according to the selection criteria set out in the rules Article 7.*

*The project description **must use the headings** on page 2. The structure of this document and the font must not be changed. The **minimum font size** allowed is **11 points** and the font type is **Arial**. The maximum number of **6 pages** should be respected. You can insert texts, images or drawings.*

Team name: NIC

Project title: The Eyes of Windshield

Abstract (15 lines max):

This project involves discovering methods to improve visibility for the driver in difficult weather conditions.

Using thermal imaging camera as well as standard camera with infrared illuminator will allow to capture different views of the road at the same time.

Thermal imaging outputs warm objects, such as cars, pedestrians or animals as bright shapes while normal camera adjust itself automatically to different light exposure, producing good quality images most of the time. IR illuminator allows normal camera to work also at night.

Standard camera is able to focus on farther objects unlike human eyes, thus is able to see farther.

Processing these images by computer vision software provides possibility to find obstructions and detect lanes, since the images are less (or not at all) affected by current weather conditions or time of the day. Objects found by the computer will then be clearly shown on the windshield, overlapping real things with their amplified substitutes.

Better view might give a decent improvement, allowing us to ride hopefully safer and more comfortable.

1. What is the problem? Or situation to improve?

The problem is poor visibility on many roads during bad weather, for example at night, in winter, during the rain and snowfall, in strong sun or in the fog. Bad visibility poses a higher risk of road accident to driver, therefore it requires from him paying much more attention than usually.

Beside of feeling discomfort, the driver must slow down to embrace whole road in time. Avoiding visibility issues would allow to ride faster and with more confidence.

2. What is/are the current solution(s), if any?

There are no complex solutions at this time, however impact of this problem is partially reduced in some circumstances:

- Headlights are used in night
- Foglights are used in the fog

The idea behind these solutions is to extend the range of human eyesight.

3. What is your solution?

The aim of our project of the windshield is to improve the visibility for the driver in difficult weather conditions: at night, in the fog, during the rain and snowfall or in the strong sun.

Really important things on the road, such as lanes, curbs, turns, other vehicles, pedestrians and animals will be clearly marked on the windshield, meaningfully improving safety and facilitating the ride.

The most significant components of the project are:

- a standard camera
- an infrared illuminator for night vision
- a thermal imaging camera

They will be placed on the car 's front.

The cameras will work simultaneously the whole time while the IR illuminator will be enabled only at night.

Multispectral imaging allows to show objects in pretty all weather conditions, as both cameras used in the project operate in some circumstances better than in others.

A standard camera sees farther than human eyes, adjusts the light exposure fast and automatically. An additional IR illuminator allows a normal camera to operate efficiently also by night, so we can use it also then.

Detecting radiation in the infrared range using thermographic cameras works best for seeking pedestrians, animals and cars' exhaust.

In addition, the captured image remains unaffected in the daytime, fog and even heavy rain- or snow.

The resulting images from both cameras should be analysed by the computer.

An important part of this process will be lane detection. It is easy to achieve with any computer vision software, e.g. openCV or MATLAB. Images from a standard camera are appropriate for searching straight lines as well as curves.

Detecting other vehicles or people is also possible in this image, however at this point thermal imaging camera fits most. Warm objects in its image are shown with bright colours, which are easily-detectable by software.

The performance of computers nowadays is more than sufficient to perform those tasks in the real time, not to mention devices in the future.

Lines and obstructions found in the images will be displayed on the windshield, so that the real view will be overlapped with an amplified image, thus improving visibility. Of course, some calibration might be needed in order to exactly overlap both images. It could be changing dimensions of the image or bending it slightly, which will also be done by the computer.

Displaying on the windshield may use the same technology that a few cars with HUD displays have. Otherwise, a special transparent foil, used also to display advertisements in shops' windows with a video projector can be placed on the windshield to solve this problem.

Such a windshield will mark important objects without distracting the user. It should make the ride easier and improve safety.

Finally, to get better understanding of the project here are some sample images :



Real view



Real view
+ thermal imaging



Real view
+ thermal imaging
+ lane detection



Real view



Real view
+ lane detection



Real view

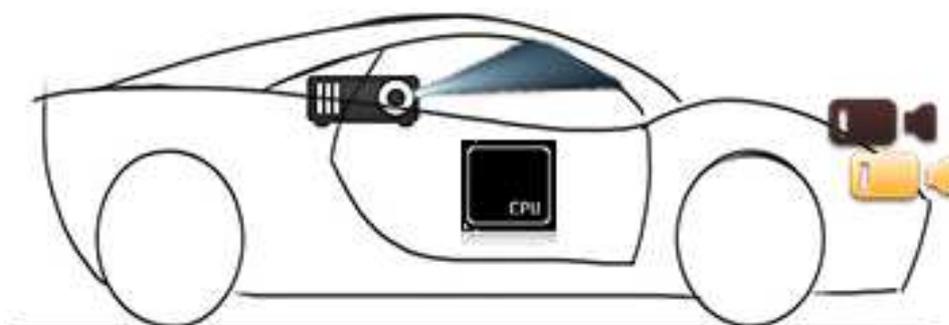
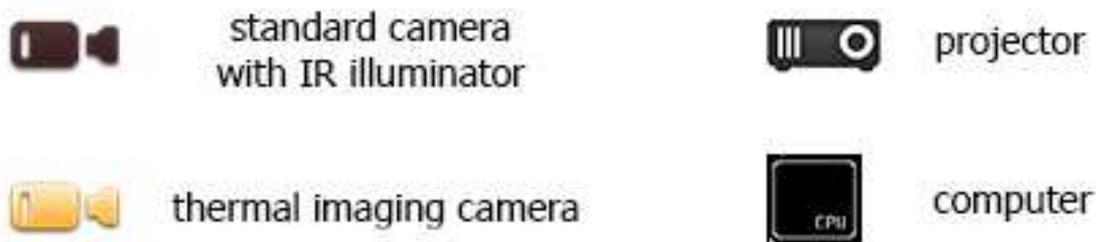


Real view
+ camera with IR illumination



Real view
+ camera with IR
illumination
+ lane detection

Simple diagram of complete system



4. What type of mock up are you considering and how do you plan to build it? (Proposal for Phase 2)

As the components of whole system shown on the diagram above are widely accessible, we are considering building real working prototype within funds' limit for Phase 2 (of course without the car).

Connecting two cameras and a video projector to the computer isn't problematic at all. The only thing we need to spend our time on is developing a program to recognize all objects mentioned in the description. There do exist some algorithms doing similar tasks, which are already implemented in popular computer vision libraries. Adapting them to road conditions might need some attention, but duration of Phase 2 is long enough to make it reasonably good.