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## CAR DIAGNOSTICS USING SOUND

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### ABSTRACT

The “mechanic’s ear” is a special aptitude developed by trained car technicians that allows the detection of problematic behaviours in cars, based mostly on the perceived sounds from the rotating motors, either idle or in motion, and wheels, shafts, bearings and other parts during driving conditions. An instrument able to emulate this sonic information usage through quantification and digital processing could be advantageously used at car repair shops, either by helping the trained mechanic with objective data but also by allowing some diagnostics to be performed by operators with limited skills. The data base of identified and registered malfunctions is still limited, but is growing and will allow more detailed problem diagnostics in the near future. The device is simple to use, robust and low priced, in order to be handled at the floor shop by limited training users, withstanding some rough manipulation and with a cost low enough to not be considered the very special piece of equipment reserved for a small number of operators. Its use is intended to be such as that almost any employee with a minimal knowledge should be able to operate it in reasonable conditions and the collected data usable either for direct diagnostic and/or recording for further work.

**Keywords:** car, sound, diagnostics, automobile repair workshop.

### INTRODUCTION

Currently it is possible to find on the market equipment that automatically performs a series of diagnostics for vehicles (built from 1996) and managed by the manufacturers through their representatives or independent, with generic application for most brands, but developed in collaboration with car manufacturers themselves. One of the best known is the VAG-COM system [VAG-COM, 2014], a diagnostic system developed for vehicles of the brands Volkswagen, Audi, Seat and Skoda. Connecting a cable to the onboard computer of the vehicle the OBD plug ("On-Board Diagnostics"), this system allows access to information from the sensors present on the vehicle and the registered error situations, thus identifying a large amount of faults.

Within this type of equipment it is possible to find a wide range of models and specifications for the vast majority of car brands [UOBD2, 2014]. This diagnostic method was introduced during last century 80’s through the incorporation of warning lights in case of malfunction of a vehicle’s component. Currently, due to the introduction of more sensors in cars, there is a great amount of accessible information, which led to the creation of a set of codes that identify the different faults [OBD-II, 2014]. This type of equipment have as a major advantage the fact that allow to sense quickly and in a simple way, a large number of breakdowns and faults in automobiles. Their main drawback is that based the diagnosis on the information provided by various sensors, which can lead to diagnostic errors if the sensors are not working properly, although some kind of malfunction diagnostics is included.

There are also some devices on the market that allow detection of air leaks using ultrasounds [Superior AccuTrak, 2014]. These devices transform the air escape on an audible sound thus allowing the user to find their origin. The developed "all-in-one diagnostic system of automobile maintenance and repair support" is designed to bring together, in a single device, the capability to record relevant data, for both sound and image, with signal processing capabilities for objective diagnostics.

## RESULTS AND CONCLUSIONS

The developed prototype was made available for use in car workshop environment (Fig.1).

The project objectives were achieved: the prototype complies with the specifications of desired use, is a device with reduced costs and it can evolve for a product family of narrower application (only image or sound), or for more sophisticated systems such as niche applications in competition, in quality control and others. Although the collection of samples of defects is still beginning and well under the desirable numbers, the device is already able to achieve 80% of valid diagnostics.



Fig. 1 - The Sound Recording setup in operation

A set of suggestions and modifications were proposed and included whenever feasible and compatible. The latest version was chosen to be installed in various car repair workshops shops in addition to the "Lúcio Machado, Engenharia e Serviços". The next step, upon receiving the larger set of test results from the car workshops, will be worked to allow a better validation and include a broader set of identifiable malfunctions to enrich the operating scope.

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