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## DIPLOMA PROJECT

Automatic tire-markings detection & recognition

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**BUCHAREST**

2022

## **CUPRINS**

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## **ABSTRACT**

This work shall provide an image processing pipeline for automatic detection and recognition of tire-markings from images. Because tires can be one of the most expensive perishable components of a truck, they are susceptible to illegal swapping with lower quality ones without the owner noticing. My solution shall provide an easy way to extract from an image the serial code and/or certification number in order to aid an individual to realize a swap happened. At the moment the system can identify a wheel in an image and "unwrap" it in order to obtain a rectangular image.

## **SINOPSIS**

Această lucrare o să ofere o bandă de procesare a imaginilor pentru detectarea automată și recunoașterea marcajelor de pe marginea unui cauciuc. Deoarece cauciucurile pot fi unul dintre cele mai scumpe consumabile ale unui tir, există riscul să fie schimbate ilegal cu unele de o calitate mai scăzută fără ca proprietarul să observe. Soluția mea va oferi o metodă ușoară de a extrage din imagini codul de serie și/sau numărul certificării pentru a ajuta un individ să realizeze că un schimb a avut loc. La acest moment sistemul poate identifica o roată într-o imagine și să o "desfășoare" pentru a obține o imagine dreptunghiulară.

# 1 INTRODUCTION

Tire markings — consisting usually of: serial code, certification number, manufacturer name, maximum load, construction materials etc. — consists valuable information for fleet operators. Using an automatic system can help prevent human error when it comes to data collection and interpretation during routine checks and free manpower to perform other tasks that are yet infeasible for a machine to do.

I intend for this technology to leave the laboratory and reach a technology readiness level (TRL) of 5 — validated in relevant environment. Because of this a high accuracy in the results is needed while taking images using normal cameras in natural lighting conditions at day. Normal image sensor found in commercial off the shelf cameras are enough as long as the image resolution is big enough to capture details of the tires and a human is able to see the markings and codes, with usage they start to fade-off in time. A big component that also affects the readability of the text in the taken photos is the presence of light.

The difficulty of the problem comes from that in most cases, tire manufacturers use for tire-markings embossed letters of the same color as the tire itself (black on a black background) and this gives a low contrast in the image (as can be seen in Figure 1). This design choice of the tire manufacturers is a major factor in determining to what extend the environment (like tire cleanness and light conditions) must be controlled.

A standardized unique serial number to differentiate a tire from another is practically nonexistent. Depending on the region the tire manufacturer sells the respective tire model, there are some codes the governments mandate. The most widespread one is the "DOT code" (Department of Transportation Code) that the United States of America forces the manufacturers to use and an example can be seen in Figure 1. Another usually present code on the tire is the E-mark that is mandated in Europe and can be seen in Figure 2.

Practically in order to uniquely identify a tire only by markings is impossible in the current legislation, but a combination of the present codes and the other specifications present on it should be enough to closely identify a tire and create its "fingerprint". So our system has the task to find these 2 codes when present and preferably any other ISO metric codes regarding the specifications of the tire.

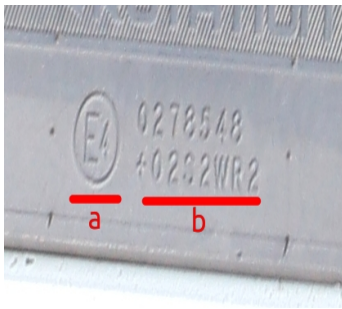


Figura 1: E-mark

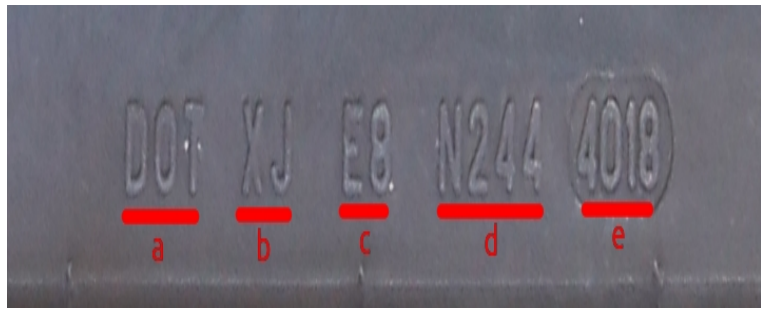


Figura 2: DOT code