**Software Requirement Specification**

for

**GABot**

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28th August 2016

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# Revision History

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| **Name** | **Date** | **Reason For Changes** | **Version** |
| Main Document | 29th August 2016 | First version preparation | 1.1 |

# Introduction

## Purpose

The intended product is a prototype of an autonomous vehicle that is able to navigate and drive on its own without the intervention of a human element. The bot (vehicle) can avoid any obstacles in its path in order to arrive at its destination safely.

## Document Conventions

The priorities mentioned in the functional requirements are in bold for emphasis. Similarly, bold characters are used for emphasis on specific topics.

## Intended Audience and Reading Suggestions

The intended audience is the project review committee and the project mentor.

* **Project Review Committee:** The main focus for the review committee would be the validity and feasibility of the scope of the said project. The review committee may brief through the overview and focus on the system features and other non-functional requirements.
* **Project mentor:** The project mentor may go through the overview of the SRS and may focus more on the external interface requirements, system features and the non-functional requirements.

## Product Scope

The autonomous bot will be mounted with a camera at front which will record a video of the surroundings straight ahead of the bot. It shall then splice the video into frames where each frame will be analysed to detect the presence of obstacles. Depending on the situation, the car will decide its movement. Situations include – Obstacles, road signs and symbols.

## References

# Overall Description

## Product Perspective

This product is a prototype of the already in-progress development of self driving vehicles. One of the popular examples of such a vehicle would be that of Google’s self driving car. The proposed product attempts to achieve autonomous behavior similar to Google’s self driving cars on a smaller and feasible scale.

## Product Functions

This product will be able to perform the following functions:

* Detect and avoid the obstacles in its path.
* Identify the type of obstacle (whether it can be overcome or not, e.g. a small bump in its path)
* Identify any traffic signals in front of it and move/stop accordingly.

## User Classes and Characteristics

This product being a prototype of a much larger product does not cater to the needs of any user class. Although, a complete version of the product (real life size model) shall cater to the needs of the general masses in the form of a regular automobile that has the ability to drive to its destination on its own with minimal human intervention. Such a product may me widely used by cab companies to replace their human driven cabs with the new autonomous alternatives. Once completely tested, any user may access the services of the real life product without any special technical/educational expertise.

## Operating Environment

This product shall work on Windows operating system and shall use Matlab as the major operating environment. Apart from this, it shall incorporate the services of hardware components such as Arduino microcontroller, motors, batteries, etc. The image processing shall be performed using Matlab which will be used in sync with Arduino IDE which in turn is responsible for controlling the hardware components of the product. The product shall operate in open surroundings with suitable assumptions and controls.

## Design and Implementation Constraints

Following design and implementation constraints are endured:

* Being a prototype, the entire computation cannot be done on the device itself. Thus the bot shall be connected to a laptop via the USB port in order to perform the complex image processing mechanisms.
* Using small scale motors and batteries, the bot shall use the laptop as the main source of energy.
* Being at a rudimentary stage, the bot shall not simultaneously drive and process its surroundings; the bot shall first process its surroundings and then accordingly move/stay.
* Sudden obstacles cannot be detected.

## User Documentation

No formal user documentation as yet.

## Assumptions and Dependencies

Following assumptions and dependencies exist for the product to function:

* Since this product uses many hardware components, the product assumes that each hardware component performs without any errors.
* The video captured by the camera on the bot does not have unwanted ambient lighting (reflections on floor) which may compromise on the product’s ability to process the video frames efficiently.

# External Interface Requirements

## User Interfaces

TBD

## Hardware Interfaces

The software part of the product shall be performed by Matlab which relays relevant information to the Arduino IDE, which in turn controls the microcontroller that controls the motor of the vehicle (bot). This is done by using the in-built libraries that allow communication between Matlab code and Arduino code by the creation of an Arduino object in Matlab.

## Software Interfaces

The major software used is Matlab that runs on Windows operating system. Another software interface that plays an important role is the Arduino IDE which is a development environment for developing Arduino codes. This IDE works in collaboration with the Matlab. Matlab is responsible for processing the video captured by the camera. After processing, the outputs are then checked against appropriate conditions. Accordingly, the relevant output is relayed to the Arduino chip which runs/stops the motor that controls the movement of the bot.

## Communication Interfaces

The product mainly implements the Matlab-Arduino interface for transfer of image processing output data which will be used for manipulating the movement of the bot.

# System Features

## Obstacle Detection

### Description and Priority

This feature deals with the ability of the bot to detect any obstacle that may be in front of it. Since avoiding collisions with is the prime concern of any vehicle, this functional requirement is **high priority**.

The risk involved with this feature is also a **high priority** risk as it pertains to the purpose of driverless vehicles- safety.

### Stimulus/Response Sequences

A short video is captured by the camera placed on top of the vehicle. This video is then immediately processed using appropriate image processing algorithms to detect the presence of any object that may hinder the safe movement of the bot.

### Functional Requirements

1. The camera must capture proper videos of appropriate duration.
2. The bot must be stationary while capturing the video.

## Image identification

### Description and Priority

This feature deals with identification of the surrounding that is captured by the camera. This includes identification of traffic signal lights and signs. Since traffic rules are of utmost importance for road safety, this feature is of **high priority.**

The risk involved with this feature is also a **high priority** risk as it pertains to the purpose of driverless vehicles- safety.

### Stimulus/Response Sequences

After obstacle detection, assuming the absence of any obstacle in the path of the bot, the captured video is processed for presence of any traffic signs (such as stop lights). If any such component is captured in the video, appropriate signals are sent to the hardware.

### Functional Requirements

1. The color of the traffic light should be correctly analyzed.

# Other Non-functional Requirements

## Performance Requirements

The sequential execution of various processes is paramount for safe navigation. The video must be captured and processed in minimal time which in turn reduces the waiting time of the bot. the obstacle (if any) must be detected by the image processing algorithm for the bot to decide whether it should move or not.

## Software Quality Attributes

TBD

# Other Requirements

# Appendix A: Glossary

* TBD- To Be Decided
* Bot- Robotic vehicle

# Appendix B: Analysis Model

# Appendix C: To be determined list

* Software Quality Attributes- adaptability, robustness, reusability, availability, maintainability.
* User Interfaces