**Ministry of Higher Education**

**University of Mannouba**

**National School of Computer Sciences**

**Software Requirements Specification**

**Prepared For master and engineering graduation internship**

Realised by

**Chayma MOUSSA**

Topic

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| **Implementation and development of a multi-sensor mobile vision system (2D color, 3D, IR)** |



**Organisation : Vilmorin-Mikado**

**Responsible: Mr. Ali BOUJEDRA**

**Academic supervision: Mrs. Faryel MOURIA-BEJI**

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Signature & Stamp of the Organization

Academic year : 2020/2021

1. **Introduction**

This work is part of the graduation project to obtain a computer engineering degree from the National School of Computer Science of Tunisia. The work is done within Vilmorin-Mikado, at Ménitré, Angers, France, during the period from March 15 to August 31 2021. The responsible of the project is Mr. Ali BOUDJEDRA, a project leader of Computer Vision and automation.

1. **Host Organisation**

Vilmorin S.A. (Anonymous Company) is an international French company, selling its products in more than 100 countries and being part of the Limagrain group.  
Vilmorin S.A. now focuses on seed production and marketing vegetables and trees, only for professionals such as market gardeners, producers of plants, industrials.

1. **Context and challenges**

The Limagrain Cooperative specializes in field crop seeds, vegetable seeds and cereal products. At the service of its members, the cooperative is centered on different value chains for its crop products. It ensures the monitoring, collection, processing, storage and marketing of its products.

The Limagrain plants large varieties of vegetables such as lettuce and cauliflower. For lettuce, Limagrain plants between 250 and 300 varieties. Lettuce, depending on the species, has different characteristics such as the volume, color, foliage, shape of the leaves. They are planted in the tunnels of Limagrain and after 4 weeks they are transferred and planted at its producers in different countries.

Some vegetables have off-types. For lettuce, some have distinct colors than others, some have a different volume than others, some have a different shape of Leaves, some have no center. These must be removed but it is not for the profit of the producers; they will lose money as they are paid in kilos of production, also the Limagrain experts cannot visit the fields that are in several countries.

1. **Objectives**

The aim of the proposed work is to automate the monitoring lettuce and other vegetables production by developing a characterisation and phenotyping solution under uncontrolled conditions, consisting of a multi-sensor mobile vision system (2D Color, 3D, IR) on Android, to help Limagrain expert monitor the production of vegetables remotely.

## Functional description of requirements

* Make a state of the art on the subject of combining three sources of images (2D color, 3D, IR)
* Participate in the collection of relevant images of lettuceand other vegetables
* Integration of vision and data fusion on Android system
* Detect off-types of vegetables from various varieties using ML and classification

## Non-functional description of requirements

* **Reliability and availability:** The system must work 24 hours per day and 365 days per year all time or permanently.
* **Performance :** The application must be effective to the extent that the detection of off-lettuces must be carried out in reasonable time.

## Design

For the design of our project, we will use the UML modeling language. Thus, we will use :

* Use-case Diagrams
* Sequence Diagrams
* Activity Diagrams
* Class Diagrams

## Realisation

## The achievement of our project will be according to the following steps:

Phase 1 :

* Study of the state of the art of merging RGB image and IR image
* Generate the fusion models and test the performance

Phase 2 :

* Study of the state of the art of merging 3D image and 2D image
* Generate the fusion models and test the performance

Phase 3 :

* Classification system for the detecting of off-type lettuce and other vegetables

Phase 4 :

* Development of the mobile application

1. **Development Environment**

**Hardware Environment**

* Galaxy Note 10 + : provide a high camera resolution equal to 4032 \*3024 pixels thanks to 3 rear cameras adding to a Time Of Flight sensor
* FLIR ONE PRO ANDROID: provide infrared images with resolution equal to 160\*120 pixels

**Software Environment**

* Tensorflow, Tensorflow lite, Python, Android studio, Latex

1. **Estimated chronogram of the project**

