Universidad Politécnica de Madrid

Escuela Técnica Superior de Ingenieros Industriales

Máster en Automática y Robótica

Computer Vision

Driving Drowsiness Detection - First Delivery

Ivonne Quishpe (23146)

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1.1 Overview

- **Project name:** Driver Drowsiness Detection
- **Project duration:** 20.09.2023 - 02.01.2023
- **Project goal:** create a program that detects driver's drowsiness through computer vision
- **Budget:** 285 hours

1.2 Reports Evolution

No.	Start Date	End Date	Description	Prepared by	Approved by
1	20-09-2023	04-10-2023	1st Deliverable Report	All members	G. Maldonado

Table 1: *Project Milestones*

1.3 Scope

This project plan report will outline all the key aspects of the planned implementation of the project. It will begin by introducing the team members, their roles within the team and the reasons why each is suitable for their role in working on this project. It also aims to present the reference benchmark chosen for the project and the motivations behind this choice, taking into account its impact on the socio-economic aspect as well as on the Sustainable Development Goals (SDG) approach.

The plan shows the stages of the project, and the distribution of the tasks to be completed according to the agreed dates, as well as the use of the available resources, in this case, the time to be spent in each of the stages.

1.4 Team Composition

A) Team Members (Registration ID)

- Ivonne Quishpe (23146)
- Micaela Cabrera (23023)
- Gustavo Maldonado (23102)
- Jorge Guijarro (23075)
- Josep Mª Barberá (17048)

B) Roles & Responsabilities

Team Member	Role	Responsibilities
Jorge Guijarro	Project Manager	– Project planning – Team coordination & communication management – Resources allocation management – Budget management
Josep Mª Barberá	Programming	– Code management – Programming environment setup – Architectural Design and Interface Specification – Assembly of code sections into main code – Code quality and troubleshooting – Documentation of programming process
Gustavo Maldonado	Documentation	– Preparation of deliverables reports – Collection of information on the different areas of the project – Documentation of the whole project and Final report – Website creation
Ivonne Quishpe	Technical project manager	– Project goal determination – Technological research coordination – Technological progress assessment – Documentation of Technological tasks
Micaela Cabrera	Testing and validation	– Testing and results interpretation – Assessment of results – Generalization of results – Documentation of tests, evaluations, and results

Table 2: *Team Roles and Responsibilities*

Attributes considered when assigning the roles of each team member:

- **Project manager:** The coordinator of this area has been chosen due to his experience in coordinating and organizing teams in different academic (university projects) and extra-academic environments. The results obtained in all cases have been satisfactory.

- **Programming:** The chosen manager has sufficient programming experience (from undergraduate studies and extracurricular internships). This experience is based on the use of languages such as C++ and Python for data analysis, which we believe will be very useful in this project.
- **Documentation:** The selected individual for the position presents strong writing skills, coupled with previous experience in preparing reports and documentation on various academic projects during his undergraduate studies. In addition, the high proficiency in the requisite language makes him suitable for this role.
- **Technical project manager:** The person in charge of this section is knowledgeable and open-minded when it comes to research, exhaustive analyses, comparative documents, papers, etc. The person in charge of this section has the ability to discern the information found and at the same time generate ideas and feasible arguments when carrying out or choosing a satisfactory research.
- **Testing and validation:** The person responsible for this area has worked for two years as an engineer of technological projects where she has performed testing and debugging of various automation programs, so it is considered that her knowledge and experience will allow a correct evaluation of the implemented algorithm.

1.5 Benchmark

The main goal of the project is to use a benchmark available to design a program which implements computer vision and that will have a positive impact. Different benchmarks were proposed by each team member, and aspects as SDG (Sustainable Development Goals) and Socio-economic impact were taken into account when selecting one.

The benchmark chosen is the one of **driver drowsiness detection by analysis of images of the eyes** (please refer to Fig. 1). The aim of this benchmark is to be able to determine whether a driver has a certain level of drowsiness by image processing and analysis of the eyes of a driver with the purpose of implementation in accident prevention systems caused by driver's with a certain level of fatigue. An example of such a system in semi-autonomous and/or autonomous vehicles would be one in which the vehicle takes control of the car and takes it to a halt when drowsiness from the driver has been detected.

Despite other same approaches has been done before [7], reproducing and improving same results can be important for further investigation and research.

Two possible datasets avaible are:

- CVC11: DrivFacce from the CVC research center and the UAB and UPC universities. Donwload here [3].
- MRL Eye Dataset the large-scale dataset of human eye images. Can be downloaded from [5]. And this publication [4] supports this dataset.

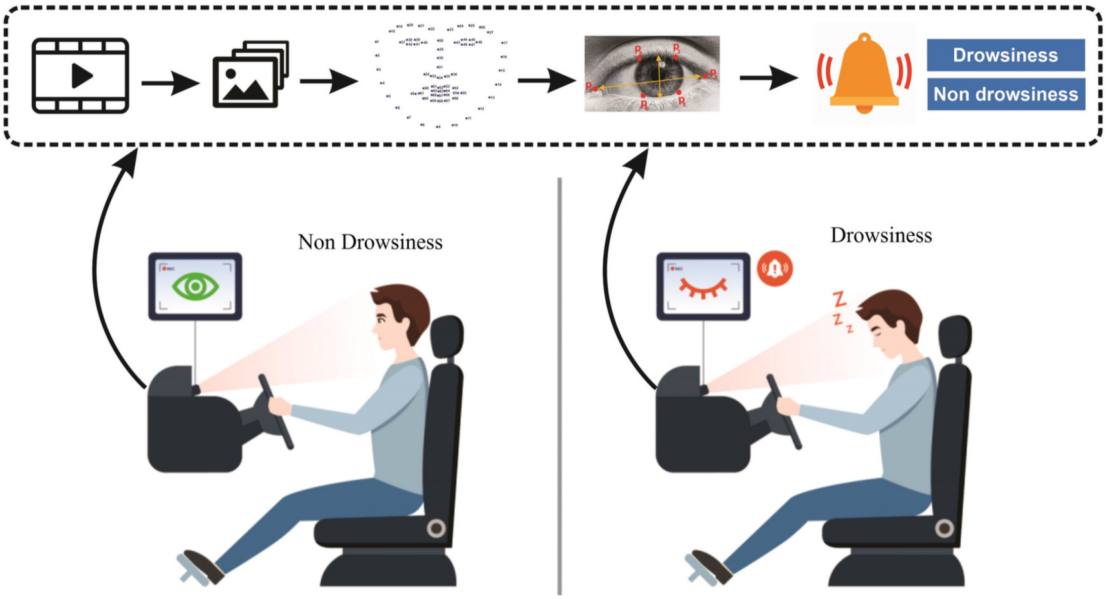

Figure 1: *Driver drowsiness detection architecture from [7]. We are working on replicating this research to achieve similar results.*

1.6 Socio-Economic Impact

From an economic point of view, traffic accidents are very expensive. The cost of road traffic fatalities is estimated at around 1 million euros, while the cost of an injured person is between 23,000 and 143,000 euros. The total amount of road accidents in the European Union exceeds 100 million euros. Since a quarter of an accident is directly related to driver fatigue or drowsiness [1]. Today, technology exists that attempts to address this problem (see FIG. 2). However, research in this field is still in its early stages and there are a multitude of technical and scientific approaches to be developed that could bring significant improvements to current drowsiness detection systems.

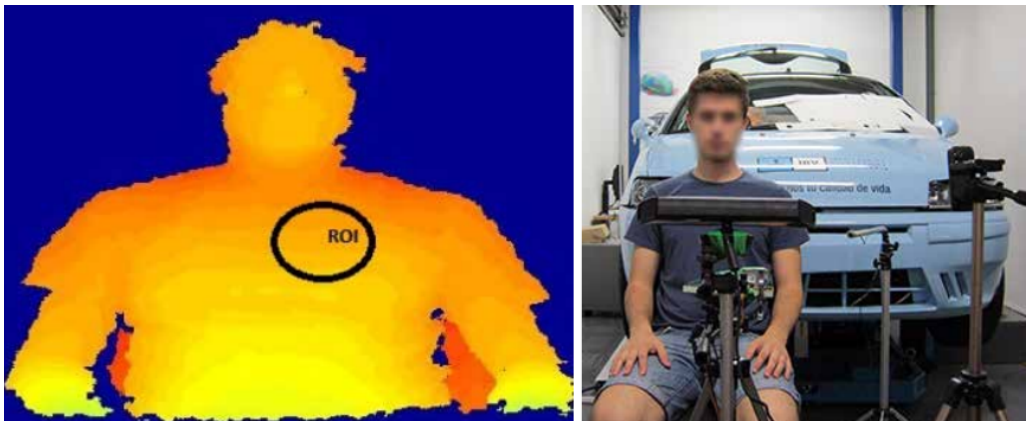

Figure 2: *Depth map recorded by KINECT (left) and real image of the subject (right). This study aims to validate the use of a KINECT camera to measure respiratory rate, which in turn allows this device to be used to detect driver drowsiness. Source: [1].*

1.6.1 Sustainable Development Goals

The development objectives of this project are aligned with goal 3 of the 2030 agenda [6] "Health and well-being", specifically with goal 3.6 that seeks to reduce the number of deaths and injuries that occur as a result of traffic accidents worldwide. It is estimated that tiredness or fatigue in drivers is related to 15-30% of traffic accidents in Spain alone [2], being able to determine the level of fatigue in drivers allows developing alarm systems and action plans that reduce the number of accidents on the roads and their fatal consequences, an action that is also related to SDG 11 "Sustainable cities and communities" which has as one of its goals to provide people with access to safe transportation systems and improve road safety in cities.

(a) (b)

Figure 3: *Sustainable Developtment Goal number 3 (a) and 11 (b) are contributed thanks to this project.*

1.7 Planning

In the planning, the following rules have been followed: first, a deadline for finishing the job has been set for January 2, 2024. In this approach, the work's completion will not have a big impact on the students' study for the normal January tests. On the other hand, the date for the work's follow-up meetings has been set as Wednesday. There will be 16 meetings, each with a set time limit of one hour. We arrive at a total of 57 hours of work by adding the meeting time and the work time of each student.

Regarding the planning, we have created a Work Breakdown Structure (WBS) for the project (please refer to Fig.4). Subsequently, based on the list of tasks and activities, we have prepared a Gantt chart (visible in Fig.5) in which the designated amount of hours to be spent per person on each delivery is shown.

Additionally, as appendices to this document, we have included the minutes of the two first meetings held by the group.

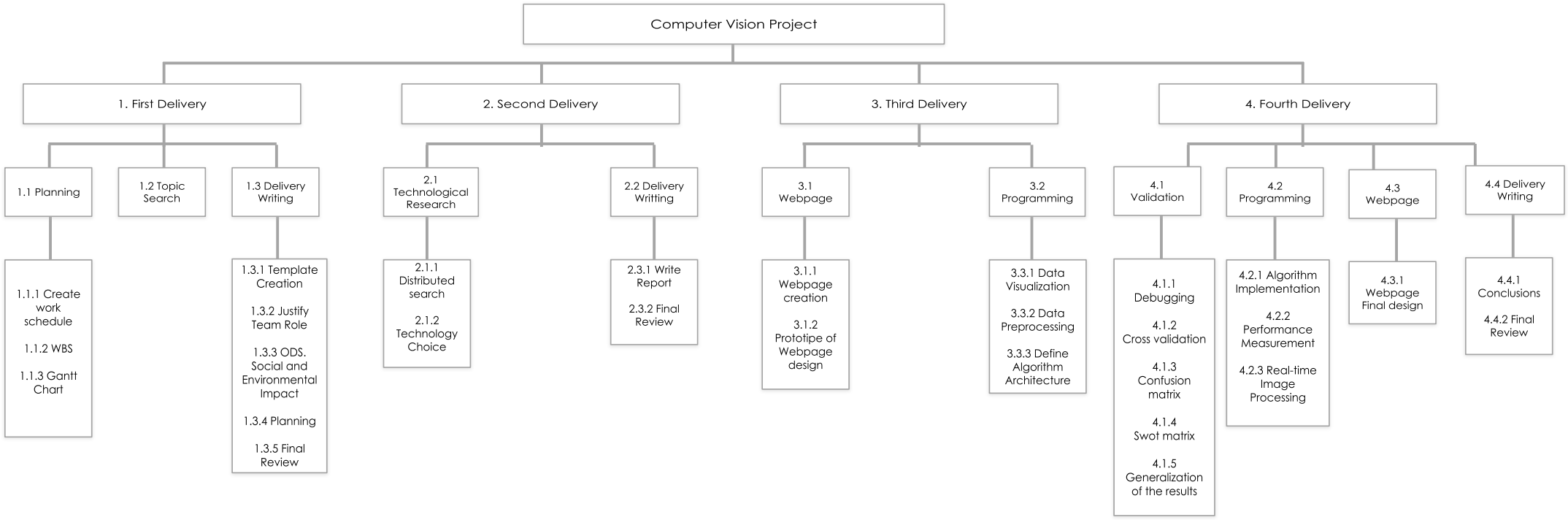

Figure 4: *Work Breakdown Structure*

COMPUTER VISION PROJECT

	0	2023-09-20	2023-09-20	2023-09-27	2023-10-04	2023-10-11	2023-10-18	2023-10-25	2023-11-01	2023-11-08	2023-11-15	2023-11-22	2023-11-29	2023-12-06	2023-12-13	2023-12-20	2023-12-27
Beginning of the project	2023-09-20																
TASK	BEGINNING	END															
PROJECT (41H+16H)	2023-09-19	2024-01-02															
DELIVERY 1 (3H)	2023-09-20	2023-10-03															
Planning	2023-09-20	2023-09-24															
Template Creation	2023-09-20	2023-09-26															
Thematic Search	2023-09-20	2023-09-26															
Writing of the 1st Delivery	2023-09-27	2023-10-03															
DELIVERY 2 (9H)	2023-10-04	2023-10-31															
Technological Search	2023-10-04	2023-10-24															
Writing of the 2nd Delivery	2023-10-18	2023-10-31															
DELIVERY 3 (15H)	2023-11-01	2023-12-05															
Website Creation	2023-11-01	2023-11-07															
Web design (I)	2023-11-08	2023-12-05															
Programming (I)	2023-11-01	2023-12-05															
DELIVERY 4 (14H)	2023-12-06	2024-01-02															
Validation	2023-12-06	2023-12-26															
Programming (II)	2023-12-13	2023-12-26															
Web design (II)	2023-12-06	2023-12-26															
Writing of the 4th Delivery	2023-12-20	2024-01-02															

Figure 5: *Gantt chart*

References

[1] E. M. et al. "Cámaras para combatir el sueño al volante". In: (). URL: https://dialnet.unirioja.es/descarga/articulo/6264119.pdf.

[2] Altran-dgt. *DGT - Distracciones al conducir*. URL: https://www.dgt.es/muevete-con-seguridad/evita-conductas-de-riesgo/distracciones-al-conducir/.

[3] *CVC11: Driver Face Dataset (DrivFaCCE) – Elektra*. 2016. URL: http://adas.cvc.uab.es/elektra/enigma-portfolio/cvc11-drivface-dataset/.

[4] R. Fusek. "Pupil localization using geodesic distance". In: *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* 11241 LNCS (2018), pp. 433–444. DOI: 10.1007/978-3-030-03801-4_38.

[5] *MRL Eye Dataset — MRL*. 2021. URL: http://mrl.cs.vsb.cz/eyedataset.

[6] R. Neshovski. *Goals - United Nations Sustainable Development*. Oct. 2023. URL: https://www.un.org/sustainabledevelopment/.

[7] A.-C. Phan, N.-H.-Q. Nguyen, T.-N. Trieu, and T.-C. Phan. "An Efficient Approach for Detecting Driver Drowsiness Based on Deep Learning". In: *Applied Sciences* 11.18 (2021). ISSN: 2076-3417. DOI: 10.3390/app11188441. URL: https://www.mdpi.com/2076-3417/11/18/8441.

Annexes

In the following pages, the minutes for the two virtual group meetings are provided in detail, capturing the discussions and decisions made during these sessions.

Project Information			
Customer	UPM	**Name**	*Work Computer Vision*

ASSISTANTS		
Name	**Project Position**	**Registration No.**
Josep María Barberá	Programming Manager	17048
Micaela Cabrera	Validation Manager	23023
Jorge Guijarro	Management Responsible	23075
Gustavo Maldonado	Documentation Manager	23102
Ivonne Quishpe	Technology Manager	23146

INFORMACIÓN MEETING					
Date	20/09/2023	**Start-End**	18:30-19:30	**Location**	Online
Objectives	Formalizing the working group and assigning the first tasks				

ITEMS TO BE DISCUSSED	
Assignment of roles	The roles of the different members of the group have been assigned according to the "ASSISTANTS" table in this document.
Establishment Dates Meetings	It has been decided to hold follow-up meetings. The weekly meetings are held on Wednesdays at 6:30 pm.
Work Planning	The first details of the planning have been outlined, as follows as the most conflicting days for the performance of the work.
Exploring topics for work	The various databases have been searched in search of a possible working topic; however, a definitive choice will be made in the future.

TOPICS DISCUSSED
All those raised in the points of the day.
Description and responsibilities of each of the role managers.
An estimated project completion date of January 2, 2024 has been decided upon, thus that the performance of the same does not impede the study of the ordinary exams.
It has been determined that the work hour count will be conducted at the beginning of each meeting.
Python has been defined as the programming language used. And the use of Jupyter Notebooks using Google Colab as the programming environment.
Word has been defined as the text template to work with and Latex for final editing.

COMMITMENTS AND AGREEMENTS ADOPTED

No.	Description	Date of Application	Responsible	Expiration Date
0	Benchmark Search	20/09/2023	All	27/09/2023
1	Elaboration of a writing template	20/09/2023	Gustavo Maldonado	27/09/2023
2	Justification of assigned role	20/09/2023	All	27/09/2023
3	Elaboration of Planning together with Gantt diagram.	20/09/2023	Jorge Guijarro	27/09/2023

NEXT MEETING AGENDA:	YES	X	NO		Date	27/09/2023

REMARKS
None relevant.

PREPARED BY: JORGE GUIJARRO TOLÓN. RESPONSIBLE FOR MANAGEMENT

Project Information			
Customer	UPM	**Name**	*Work Computer Vision*

ASSISTANTS		
Name	**Project Position**	**Registration No.**
Josep María Barberá	Programming Manager	17048
Micaela Cabrera	Validation Manager	23023
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Ivonne Quishpe	Technology Manager	23146

INFORMACIÓN MEETING					
Date	27/09/2023	**Start-End**	18:30-19:30	**Location**	Online
Objectives	Review each student's progress and assign a final topic.				

ITEMS TO BE DISCUSSED	
Review of tasks awarded at the previous meeting	First, the writing template developed by the documentation manager (Gustavo) was discussed and explained. Later, the contents to be reflected in the first delivery were agreed upon. Benchmark research that was conducted throughout the week was then reviewed for their subsequent vote.
Choice of Benchmark and theme of the job	After the presentation of the proposals of each member of the group, a vote was taken to choose the ideal one. Finally, the proposal entitled: "Drowsiness detection" was chosen. The initial idea is to implement it in vehicles in order to detect a possible state of drowsiness of the driver.
Awarding of tasks for the completion of the first phase of the first delivery	The remaining tasks are reflected in the table below. "Commitments and agreements adopted"

TOPICS DISCUSSED
Those agreed in "Items to be discussed".

COMMITMENTS AND AGREEMENTS ADOPTED				
No.	**Description**	**Date of Application**	**Responsible**	**Expiration Date**
0	Writing benchmark justification	27/09/2023	Gustavo Maldonado	01/09/2023
1	Writing SDGs related to the chosen benchmark.	27/09/2023	Micaela Cabrera	01/09/2023
2	Social and Economic Impact	27/09/2023	Ivonne Quishpe	01/09/2023
3	Transfer to PDF EDP and Gantt.	27/09/2023	Jorge Guijarro	01/09/2023

NEXT MEETING AGENDA:	YES	X	NO		Date	04/10/2023

REMARKS
None relevant.

PREPARED BY: JORGE GUIJARRO TOLÓN. RESPONSIBLE FOR MANAGEMENT