POC ROAD MAP

THE CONVEYOR (T-IOT-901)

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SUMMARY

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PART I: BUSINESS NEED

1- CONTEXT

a. Project main objective and description

The T-IOT-901 project consists of building firmware that will be running on an MCU that suits the best. (*It's important to notice that the said firmware will be autonomous and mainly loaded on the NFC hard system*).

Here is the context: The customer wants to integrate an old conveyor into his recent installation. To that old conveyor, a new version of firmware was integrated that controls all the machine components and adds network communication. Unfortunately, the project did not end appropriately due to the strange exit of the service provider in charge of the project.

Then, our goal is to develop a firmware that will wrap the existing program, work with it and add the missing features.

b. Client description

Enough information about the client is unknown. To summer up, the client owns an installation of many conveyors in which he wanted to integrate a renewed one. The renovation project was started by a service provider who abruptly quit the project before his end (*The identity of the said provider and the reasons that explained his withdrawal from the project are unknown*). Therefore, here are the elements made available by the client coming from the latest work released on the previous version of the project :

- An electronic prototype which we'll have at once in November,
- The 3D view of the controller,
- The list of the missing features that are present in the resignation email sent by the service provider.

c. The new service provider description

 The new service provider is a team of apprentices who are growing up according to different competencies. The said team is composed of:
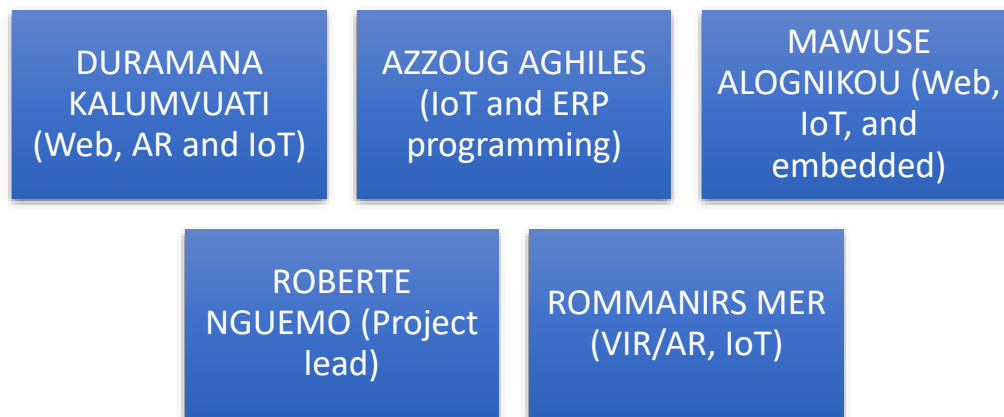
Diagram 1: Service provider team members

d. Estimated delivery time

To respond to the client's needs the service provider will deliver the following artifacts:

Table 1: Estimated delivery

DELIVERY	DATE
POC ROADMAP	09/10/2022
FIRMWARE AND TEST COVERAGE RP	05/02/2023

In addition, the client will provide a technician for some testing sessions according to the following program:

Table 2: Estimated testing session planning

TESTING SESSION PURPOSE	ESTIMATED DATE
Handling of the controller	November
WMS communication tests	December
Firmware test and debug	January

2- FUNCTIONAL SPECIFICATIONS

Based on the description and the main objective of the project, we will present in this section the translation of the user needs into functionalities:

a. NFC Reader/Writer/communication with the WMS system[1]

The following features will depend on the place where the NFC system is going to be installed.

- Firmware level

Table 3: Firmware level - NFC system

N⁰	FEATURES
1	Read the product reference from the NFC tag on the package
2	Get the destination and other useful information from the WMS
3	Create a stock movement in the WMS to the destination warehouse[2]
4	Write the stock movement information in the NFC tag on the package

- Hardware level

Table 4: Hardware level - NFC system

N⁰	FEATURES
1	Electronic building of the NFC system
2	Building of the NFC system package
3	Finalization of the NFC package

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[1] Short name = NFC system
[2] The said where house received a new package that should be update in the database

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b. Conveyor improvement

i. Motors

- Firmware level

Table 5: Firmware level - Motor

N⁰	FEATURES
1	Ensure the moving and redirection of the packages

- Hardware level

Table 6: Hardware level - Motor

N⁰	FEATURES
1	New motor electronic prototyping (*proposal to be validated*)

ii. Presence detection sensor

- Firmware level

Table 7: Firmware level - Presence detection

N⁰	FEATURES
1	Control the machine with smartness

- Hardware level

Table 8: Hardware level - Presence detection

N⁰	FEATURES
1	Presence system electronic prototyping (proposal to be validated)

iii. Interruption management

The interruption management will mainly be managed in the NFC system.

3- BENCHMARK

In the market, there are a lot of NFC readers that are ready for use and connected to many terminals but in this particular case, we need to develop one from scratch because we need to integrate it directly with the communication to the WMS. Then, what we need to care about may be the design for user-friendly-use purposes and electricity optimization and security.

Image 1: NFC readers on the market

Image 2: NFC readers on the market[3]

STRONG POINTS	WEAK POINTS
• Good design	• Not for programming purposes
• Electric security considered	• Not convenient for industrial use
• Built for multi-purpose	

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[3] Source : Amazon

4- PROVISIONAL SCHEDULE

Table 9: Provisional schedule

N⁰	Activities	Duration(days)	Start date	End date
	A- PROJECT STUDY	**25**	**29/08/2022**	**07/09/2022**
1	Users' needs	5	29/08/2022	02/09/2022
2	POC roadmap	5	05/09/2022	09/09/2022
3	Code example and prototype relative to the POC	15	12/09/2022	07/10/2022
	B- MODELING	**11**	**10/10/2022**	**21/10/2022**
4	System specification	3	10/10/2022	12/10/2022
5	System design	3	13/10/2022	15/10/2022
6	Traceability and allocation	3	17/10/2022	19/10/2022
7	Test model	2	20/10/2022	21/10/2022
	C- HARDWARE CONCEPTION	**5**	**24/10/2022**	**28/10/2022**
8	NFC system	1	24/10/2022	25/10/2022
9	Motors prototyping	3	25/10/2022	26/10/2022

N⁰	Activities	Duration(days)	Start date	End date
10	Presence detection prototyping	1	26/10/2022	28/10/2022
	D- PROGRAMMING	**20**	**01/11/2022**	**30/11/2022**
11	Firmware programming	5	01/11/2022	18/11/2022
12	Manage interruption	12	21/11/2022	25/11/2022
13	API to be used by the matching controller program	3	28/11/2022	30/11/2022
	E- UNIT TESTING	**14**	**01/12/2022**	**23/12/2022**
14	Firmware testing with code coverage	14	01/12/2022	23/12/2022
	F- SECURITY	**10**	**02/01/2023**	**14/01/2023**
16	Electrical and Material safety	5	02/01/2023	06/01/2023
17	Data availability and safety	5	09/01/2023	13/01/2023
	G- DELIVERY	**11**	**16/01/2023**	**30/01/2023**
18	Packaging	11	16/01/2023	30/01/2023

PART II: TECHNICAL OPTION

1- TECHNICAL SPECIFICATION

a. Users need summary and constraints

NEED	CONSTRAINTS	SOLUTION
Develop firmware to help old conveyor sorting packages and communicate with the WMS	Limited access time to WMS and the machine controller	**Build an NFC system with communication to the WMS. In addition a motor prototype and a presence detection system with be proposed for a future feature.**

b. Technical choices

To choose the different technologies to be used, we'll refer to the scorecard method.

i. Hardware-level

- NFC/RFID kit

NFC / Criteria	Mastery (0,4)	Compatibility (0,3)	Expertise (0,3)	Total score /1
RFID RC522	0,9	0,8	0,9	0,87
ARCELI RDM6300	0,5	0,5	0,2	0,41
RFID PN532	0,5	0,4	0,3	0,41

Based on the scorecard criteria the best choice is the RFID RC522 programming kit.

- Microcontroller

Boards / Criteria	Mastery (0,4)	Network (0,3)	Expertise (0,3)	Total score /1
ESP-32-C	0,8	0,9	0,9	0,87
ESP-12-F	0,9	0,8	1	0,9
Arduino Uno + ESP 01	0,9	0,8	0,9	0,87

Based on the scorecard criteria the best choice is the ESP-12-F board.

ii. Software level

Framework / Criteria	Mastery (0,4)	Library (0,3)	Expertise (0,3)	Total score /1
Espressif (C/C++)	0,5	0,5	0,2	0,41
Arduino (C/C++)	0,9	0,8	1	0,9
MicroPython (Python)	0,5	0,4	0,3	0,41

Based on the scorecard criteria the best choice is the Arduino framework based on C/C++ programing language.

2- SECURITY

As far as security is concerned, we will implement it according to three main axes:

- Data level: all data that are going to be manipulated will be encrypted with the MQTTS protocol

- Electricity level: The connectivity between the bords and the sensor will be chosen based on consumption optimization and connection safety (*USB cable, charger bank, long-time battery*)

- Material level: A 3D model will be built especially to pack the electronic system that will be mounted

PART III: DEMO CODE

For demo code purposes here is our GitHub repository which contains:

- Code for sorting packages,
- Code for NFC reading/writing,
- Interruption management.

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