2. CALCULATIONS

2.1 Project manager’s operation, project phases and competences of members.

As it is quoted in the report of the project, the operation has been divided into five phases, and later, an evaluation will be carried out as appropriate to each of the phases.

2.2 Schematic in Google Sketch Up and Solidworks design

For the design and manufacture of parts and structures, the following software has been used:

- Firstly there were a series of structural drawings and support using Google Sketch Up.

- Then, for the mechanical manufacturing and plastic, more technical software was used. For this purpose, it was decided the use of the SolidWorks software.

2.3 Manufacture of structural testing and the final custom prototype.

Once plans were completed we went on to manufacture the parts and structural prototype.

Two prototypes were made:

First, we manufactured a structure in order to carry out basic and initial tests. The members of the team, Jose Salas and Javier Alonso, manufactured in the integrated vocational training centre facilities within the machining area.

The material used was iron with a thickness of 1.5 mm.

Once the relevant tests had been carried out we began making the final structural prototype and its corresponding supports.
To do this, and by mutual agreement of the members of the team we decided to send the final prototype to a manufacturing company specializing in plastics and methacrylate RESOPAL, located in the polygon of Maliaño, Cantabria.

2.4 Adequate selection of lighting

As quoted above, we first considered the use of a round focus LED lighting with a power of 16Watts and a colour temperature of 3000 degrees Kelvin. The dimensions of the focus for the first bracket placement are 180mm on the outer diameter and 170mm on the inside diameter.

After several tests using artificial vision, we opted to change the lighting type and use a strip of LED's white with a higher colour temperature, since quality was lost in the detection of parts and colours, which were degraded by the previous source of illumination. The used LED Strip has a temperature of 6000 degrees Kelvin.

2.5 Design of the control and use of Arduino Interface

For the control of different pneumatic mechanisms used, we opted for the use of Arduino, since this could interconnect with our software on National Instruments Labview 2012.

The Arduino, will be accessed on the PC via USB, (although the communication is actually a series and performed internally by the arduino) which also facilitates the connection. In addition, to allow communication with the software, we need "NI Labview Interface for Arduino Toolkit", which is free of charge download page National Instruments web and is installed on the arduino mediating your IDE.

To connect Arduino with the valves required the construction of interface for the adaptation of levels between the different elements, the arduino works at a voltage of 5V DC, while the valves also work at a voltage of 24V DC. For the interface, they decided to use opto-couplers type NPN, since they provide one level of security and simple transistors there no electrical connection between the part of the Arduino and solenoid valves.

A drawing is attached in the plans section with the design of this interface (Plan nr.4), the Diagram of the used Arduino (Plan nr.5) and also another plan with its layout (Plan nr.6).

2.6 Repair of conveyor belt and technical tests.

Arrival hour testing with moving parts; we opted for the recycling of a model conveyor belt already to hand in the classroom; the model conveyor belt was adapted to our needs, but with the small drawback that it did not work. To remedy this, we proceeded to disassemble it and discover the reason it didn’t work. After carrying out the relevant checks, we gave the go-ahead, but it was decided to opt for the replacement of the conveyor belt as it was old and in very poor condition and did not work correctly.

Once we got the conveyor started, we began with a speed test, to determine if the speed attained by our model resembled that which we had to meet in the Netherlands.

Our conveyor has 3 speeds, Slow, Medium and Fast, the most common speed outlined in the attached documents is Fast, a somewhat higher speed than in Netherlands but adequate for our testing.

Once these tests were finished, we mounted the box structure machine vision on the model of our tape, and from there we began to carry out the first tests in movement with Vision Builder.

2.7 Creation of the algorithm by Vision Builder and Arduino.

The operation of the algorithm is quite simple, the webcam using artificial light will fit the piece into space that we created for this purpose, then using Vision Builder we discern what that piece is by the type of material, height and colour.

For the recognition of the color of the pieces, the method to be followed will be to make a comparison with a sample (pattern) of reference established by the corresponding RAL code specified in the project.

Once we recognise the piece, we count it, and if it's one of our parts, we pull it out; for this we export our algorithm created by Vision Builder to Labview, where we will change and add code to the Manager to send orders to our Arduino, which in turn, will run the correct sequence of activation (or not) of solenoid valves with what will be the movement of the pneumatic cylinders and Therefore the successful extraction of our piece to its corresponding drawer.

Plan with the flowchart of the used algorithm and its performance (Plan nr.4) attached.

2.8 Analysis of the operation of the prototype

On the one hand we have part of the prototype machine vision analysis:

When the layout of the conveyor with tunnel vision is placed, we started testing vision in movement parts. Having placed the tunnel, the lack of rigidity of the assembly is evident, which could lead to failures in the Netherlands due to possible unwanted tape vibration, which in turn would vibrate the light in the tunnel vision, and this in turn would endanger the correct parts detection and therefore endanger the proper functioning of the machine. A change in the structure of the tunnel by changing 1.5 mm of thickness approx. iron. to 10mm thick methacrylate, is necessary. With what we gain in rigidity, aesthetic and correcting also with this fault in the prototype as the hole of light unnecessary since the light bulb was changed.

2.9 Search for possible erratic performances and provide solutions

Once located a disused conveyor belt; and after repair and making the necessary changes, it is used for detecting parts. Once mounted on the tape tunnel we check the lack of rigidity of the whole structure, raising questions about a possible alternative.

Once manufactured, it is placed on the belt and it is illuminated by a strip of LEDs to avoid hollowing the set, but the camera sees a great reflection on the inside so we have to cover it with a material anti-glare texture on the inside.

Two cylinders are ordered and once received are mounted on the structure to verify its perfect assembly. The next step is to perform the management of valve actuators.

In order to probe the behavior of the system, is needed to make a tape scale on which to practice testing including detection, positioning and removal.

Proceed to mounting the electrical and pneumatical control box and locate all together. Several tests are performed and constructed three prototypes, leaving the latter prepared for assembly in the absence of further adjustment.

Once mounted, electronic and mechanical assemble, the algorithm has to be designed. It has the mission to network and give coherence to each of the parts of the system for the coordination of the project. First with the vision of the pieces, after with the detection of position and finally the expulsion of the pieces.

After many hours of work and several solutions provided, we finally end it all and start to disassemble it in order to send it to Maastricht, where it must be assembled and adjusted once again.

MAY 2013