Outbound Technologies

PROJECT SUMMARY

Project Name:	Sunroof Assembly Line Updates
Total Value:	$512,648
Hours:	Over 3500
Engineers:	One (1) – Electrical design One (1) – Mechanical design Two (2) – Software Design Two (2) – Commissioning
Market:	Automotive
Manufacturing/Process:	Process Automation
PLC:	Rockwell – ControlLogix
SCADA:	Rockwell – RSView ME
Motion:	Robocylinder
Robot:	ABB
High End:	Visual Basic

Introduction:	OTI was contracted by an automotive sunroof manufacturer to design, build, and install the necessary electrical, pneumatic, and mechanical systems to retrofit the an existing sunroof assembly line to process a new sunroof module.
Objectives:	The existing assembly line was originally designed to process two (2) sunroof types. The focus of this project was to provide a seamless integration of the new sunroof module into the assembly line. The feature and functionality of all aspects (mechanical, pneumatic, electrical, and software) had to be maintained.
Solution:	The station-by-station solution to this project is listed below: **Station FA10 (TOX Prep)** • Add re-work part / re-introduction

- Change pallet details with color code to accommodate the new sunroof module.
- Update existing mechanical design drawings reflecting new details.
- Purchase and install new model detect sensors.
- Modify existing PLC logic to reflect new sensors
- Change banner on HMI
- Add drive tube rivet sensor
- Individual stop screen logic

Station FA20 (Auto TOX)

- New hold down clamp details
- Add software (PLC logic, HMI) configuration for new model
- Teach new TOX points
- New part locating pin details through mounting holes (front, rear, LH & RH)

Station FA30 (Auto Grease)

- Move grease heads out to accommodate new model
- Teach new servo points for new model
- Create new Change pallet details with color code to accommodate the new sunroof module.
- Update existing mechanical design drawings reflecting new details.
- Purchase and install new model detect sensors.
- Modify existing PLC logic to reflect new sensors
- Change banner on HMI

Station FA40 (Trim Lace Install)

- Change Trim Lace track to accommodate new model
- Change all details to quick change

- Add sensor for track orientation
- Add new color sensor
- Print birth certificate
- Scan bar code label

Station FA50 (Cable Install Mech.)

- Auto riveter for hard stop rivets, quick adjustable for existing sunroof modules
- Rework guarding to accommodate new part
- Move out aluminum extrusion and provide new details
- Widen cable install guides
- Add new model software
- Change servo software to accommodate both models
- New part hold downs & positions (tracks)

Station FA60 (Wind Deflector Install)

- End cap rivet sensor
- Scan roller blind bar code label
- Error proofing sensors for water management, tabs engage in slots on track (6 tabs)
- Add new sunshade sensors and brackets
- Add sensors for wind deflector and water trough
- Modify water management hold down clamp to accommodate the new sunroof module, quick adjust

Station FA70 (Motor Install)

- Provide new nesting plate
- Re-position clamps
- Extend block on timing pin locator
- New front locating pin through front mounting holes

- PLC logic for water management screws & motor screws

Station FA80 (Glass Install)

- Provide new nesting plate
- Re-position clamps
- New sensors for nesting plate
- Add part re-introduction to PLC logic
- PLC logic for (6) glass screws
- PLC logic for front hard stop rivets

Station FA90 (Install Wire Harness)

- Connector blocks for wire harness with two size connectors (total of three connectors on block), quick change over details

Station FA100 (Test - Performance)

- Modify PLC logic for the new sunroof module wind deflector
- Re-position clamps
- Re-position auto connector slide to pallet connector block
- New sensors for nesting plate
- Modify existing PLC logic for glass positions

Station FA110 (Test - Sunshade)

- Create new load cell detail for roller blind handle (different from existing sunroof modules)
- Re-position clamps
- Modify servo logic to check roller blind effort in open position

Station FA120 (Disconnect Harness - Unload)

- Scan approval label
- Print approval label
- Disconnect wire harness from pallet connector

Controls Overview:

While the base of this project revolved around modifying the existing PLC and HMI software to process the new sunroof module type, there were numerous ancillary systems that were either modified or created. These ancillary systems included modifications of the existing Visual Basic application running on the Off-Line Testing station to improve the collection of performance data and produce a secondary bar code label for production and shipping tracking, modifications to the marquee system to provide the new part information, and the development of a custom sound system to record the sound performance of the sunroof modules during the testing process. Each of these items are discussed in further detail below:

PLC
The PLC software was RSLogix 5000 Version 15. All station functions were operated via this software, including all robot and servo functions, as well as interfacing with the barcode scanners, printers, marquee, sound system, and data collection system.

HMI
The HMI software was programmed in Rockwell Software's RSView ME. There were 8 HMI stations along various stages of the assembly line. Each station was loaded with the same application, but only exhibits the functionality required for the local station based on a configuration file loaded when the application starts up.

The HMIs monitored and interacted with the system along every stage of the assembly operation and produced two pass/fail barcode labels for assembly testing and performance testing when complete.

Data Collection/Reporting
The data collection system was Rockwell Software's RS SQL which interacted directly with the PLC to collect statistical data on each product manufactured, efficiency metrics for each assembly station as well as overall assembly line performance.

Reporting was accomplished using custom SQL ad-hoc queries pulling data into Excel where it was tabulated and trended as required. Data included 50+ performance statistics for each product manufactured, uptime/downtime for each station, complete fault reporting for each station, and statistical metrics on machine cycle times and throughput.

Off-Line Tester
The Off-Line Testing machine application was overhauled to improve the collection of testing data for products that failed during the In-Line performance analysis. This was a custom Visual Basic application that collected data on the performance of each product.

The application was upgraded to store testing statistics directly to the RS SQL database and create a new table to store all failed statistics for production quality review. This allowed the end user to rework products that have failed the initial inspection so that it will pass the second inspection but still log the data on the failed product so the plant operators can make adjustments as required to improve the performance of the assembly line.

The update also included adding a new barcode printer to print a secondary performance label on products that pass inspection.

Sound Recording

A custom application was created in Visual Basic that uses several microphone inputs through a sound mixing board to audibly monitor the operation of motors in each product being manufactured. The sound files are collected, compressed and stored in individual files by serial number in real time.

Marquee

A custom Visual Basic application was modified to monitor the status of the current production run and update a 5 line marquee board over an Ethernet TCP connection.

Process Documentation:

The following is a list of documentation provided by Outbound Technologies in order to exceed the required industry standards:

- Electrical, Mechanical, and Pneumatic Drawings
- Software (PLC, HMI, robot, servo, and Visual Basic)
- Sequence of Operations / Operations Manual / Training Manual
- Vendor Documentation
- Check-Out Forms

Industry Standards:	• NEC
Project Outcome:	OTI successfully implemented the assembly line modifications over a one-week shutdown period. Plant production was never compromised and the new product successfully reached its target production rate within the necessary timeframe.