ENHANCED PERFORMANCE IN THE LEATHER INDUSTRY BY REDUCCING CHEMICAL CONSUMPTION THROUGH ARM CORTEX-M3 PIGMENT ECONOMIZER

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ABSTRACT

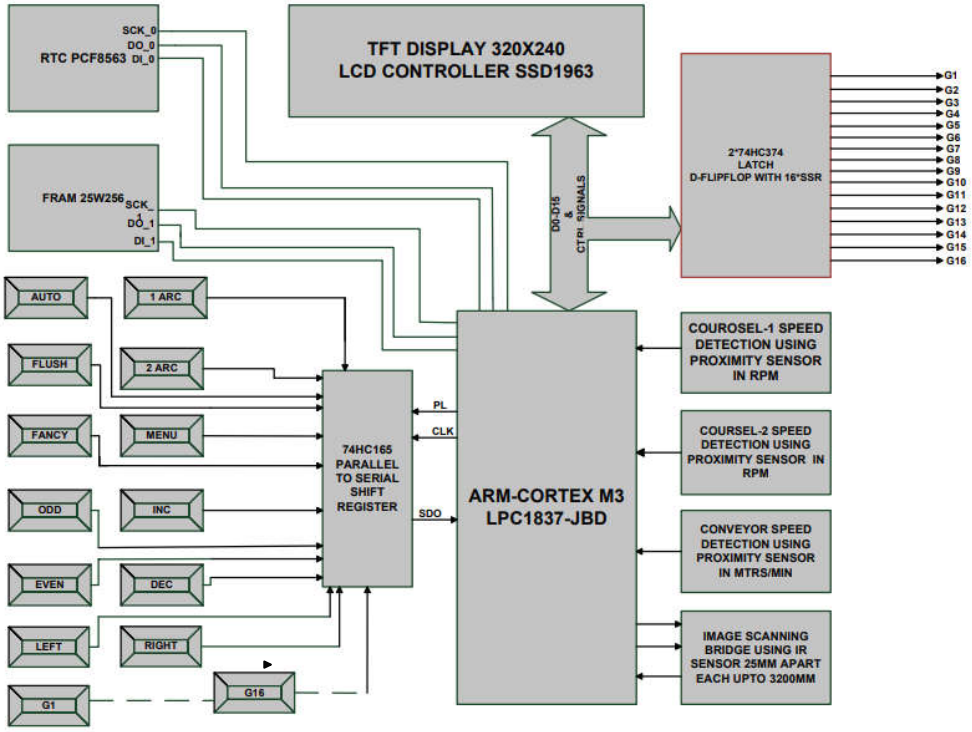
For many years spray cabinets have come outfitted with economizers and sensors to determine if the individual spray guns mounted on a rotary arm are lined up with the surface of the leather that should be sprayed. The first systems saved tanneries a lot of money, without an economizer the guns were spraying constantly while in motion. Not only was this a waste of chemical, it also caused more work for maintenance staff as the overspray would build upon the conveyor and inside the cabinet. Economizers rely on sensors to determine if the leather surface is lined up with the guns, turning them on and off as leather passes under them on the conveyor. This new system is the evolution of spray line technology in terms of resolution. The higher the resolution, the lower the amount of over spray and the less chemical waste and pigment build-upon the conveyor and inside the spray cabinet. Th eperformance of the system is directly proportion to the number of sampling points used to scan the x-yco-ordinates of the Leather and the gun position on the rotary assembly. Real Time Kernel created to handle the tasks of Gun position update, X and Y value of the leather.
Index Terms: Arc length, Y-line, Real time kernel, Carousel, Spray Gun, HVLP, ARM, Rotary Encoder.

1. INTRODUCTION

Pigment Economizer is an electronic controller unit tospray the pigment on the surface of the Leather without chemical depletion and less spray on the conveyor to curtail the maintenance, cost and pollution. The enhanced system with 32bit ARM7-CORTEX-M3LPC1837 form NXP running at 180 MHz to improve the performance of the system. Spray Guns are activated and deactivated synchronously with the movement of Leather. Leather starts moving with Convey or the moment leather reach the scanning bridge placed in horizontal direction which is upright to the movement of the convey or to capture the x value. The y value of leather is calculated from RotaryEncoder output fixed in a feeding roller. Skin image array filled from the X-Y value.

Fig: 1Auto Spray machine in Tannery

2. PROPOSED SYSTEM



3. CONSTRUCTION ANDWORKING

Carouse l: is a circular arrangement to fit an object in a real time, latency in task execution due to any circumstance ends to mal function. Contour of the circle with an equal distance. Spray gunsare fitted in an arms which is equally placed in a carouse l plate, to identify the arm position in circular movement the reference is created by providing ARM numbers maximum number of arm is 16 and minimum is 2, thediameter of the carousel should be at least 1.25 greaterthan the conveyor width. User varies the speed of thecarousel based on the article and its texture to be sprayed, speed range is 1-25 RPM. Rotary encoder 30-PPR (Pulse per Rotation) fixed in carousel arrangement to identify the exact position of the gun synchronized with the n^{th}sensorofthescanningbridgeandtocalculatetherotational speed of the carousel. Pulse output from thecarousel encoder is processed with highest priority toupdate gun position, Non Maskable Interrupt (NMI) Pin of the micro controller LPC1837 assigned to perform the Gun position up date task. Gun updating task should be in

Fig.3: Carouse l plate with Spray gun

4. CONVEYOR

A conveyor is a common piece of mechanical handling equipment that moves materials from one location to another. Leather should be placed on the conveyor in proper way to get pigment sprayed on the surface, to

identify the position of the moving leather in Y-axis rotary encoder 60-PPR fixed in conveyor roller. A pulse from the rotary encoder denotes that the leather moved for10 mm, in y-axis; every 10 mm displacement micro controller will send train of clockpulse toreadthexvalue. Pulse from the encoder processed with next priority level of gun updating task.

Fig.4: Conveyor

Fig.5: Rotary Encoder:

5. CENTRAL PROCESSING UNIT: DEVELOPED WITHL PC 1837 (ARM7CORTEXM3) FROMN XP

Semi conductor to handle the tasks process or configured to run at highest speed 180Mhz. Eventand Time driven mechanismis implemented in thecore software Kernel to handle the hardware with real time to achieve the highest performance of the system. Unit consist of Non-Volatile FRAM with SPI interface to store the Machine parameter and user setting, to log the details of chemical consumption details RTC is interfaced with I2C port. Optical isolators in CPU are so late the sensor signal from the solenoid valve power grounding.

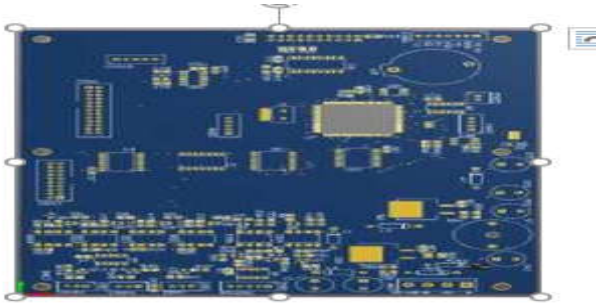


Fig.6: CPU PCB Design

Fig.7: CPU Assembled

Graphical user Interface: TFT 4.7" panel withinbuilt controller to display the information about the carouse land conveyor speed, Skin count and Total Area sprayed. if user want to select the different modeof operation via tactile switches, Alarm for the overspeedand systemfailuresand machine settings.

Fig.8: GUIin 4.7"TFT

Solenoid Valve Driver: To activate the HVLP (High volume and Low Pressure) spray guns high speed solenoid valves are mandatory, to spray the pigment on the lined up skins, guns should start and stop at appropriate timing, on and off time command is issued by the main Processor that should be followed by the solenoid valve, to achieve faster operation of spray gun less transient on and off switching device and solenoid valve is must, DC valve is the best choice.

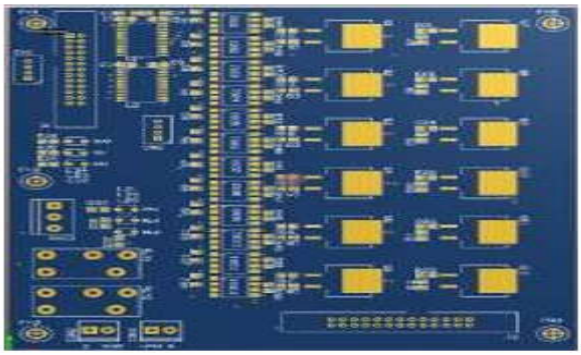


Fig.9: Solenoid valve driver PCB Design.

Fig.10: HVLP spray Gun

Fig.11:24 VDC Pneumatic Solenoid Valve

6. SCANNING BRIDGE

Constructed using photo transistor to capture leather image for Spray and to calculate Area, scanning bridge split into modules to hold eight sensors with equal displacement, the sensor outputs are framed into serial data stream using parallel to serial shift register, system can support up to 128 sensors16 modules.

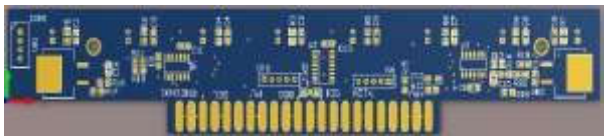


Fig.12:Photo cell module PCB design

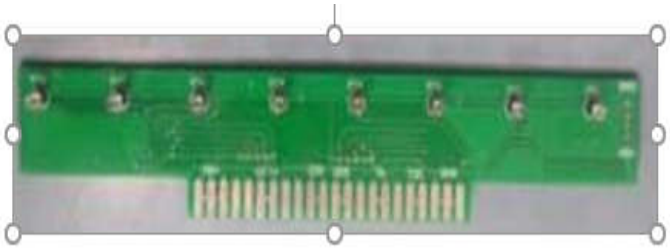


Fig.13: Photo cell module assembled

7. PRACTICAL IMPLEMENTATION

System implemented to test the performance of Guns on and off timing with LED's and to ensure the number of guns inside the conveyor indicates LED's ON and outside of the conveyor LED's OFF.

Fig.14: Prototype implementation for verification.

8. REWARDS

- Diminution in chemical consumption.
- Diminution in maintenance cost due to minimal spray over the conveyor.
- Diminution in sludge to ETP (Effluent Treatmentplant)
- Diminution in water, land and air pollution.

9. DISADVANTAGES

- Development time and cost is more.

CONCLUSION

Economizer with higher sampling points in carousel, conveyor and scanning bridge, tends to thrust the Firm ware development with Real Time Kernel to handle the task without any latency. Pigment spray onthe surface of the skin is precise, assertively chemical wastage minimized Outcome in trim down the water, land and air pollution, burning up of chemical and water a bridged. Costing and work load reduced because of negligible spray on conveyor.

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