Design Document

For

Surgical Glove's Testing Machine

Revision History

Version	Date	Prepared By	Reviewed By	Approved By	Reason
1.0	1-3-2014	C C Sreenidhin			

Table of Contents

1 Introduction

1.1 Project Name and ID

Project Name: Surgical Glove's Testing Machine

Project ID: SGTM-SW-08-10-2014

1.2 Scope of the Document

This Document describes the High Level Design for the development of Surgical Glove's Testing Machine.

This document is helpful for understanding the system to user and developer. Here we have abstract, block diagram, different system modules which helps to know better regarding the system. Looking into the datasheets one can clearly know the concept of this system. The extensibility and modifiability helps in further enhancement of this project.

1.3 Audience

The intended audience for this document is the Industrial Data Acquisition System using PC at DUXES.

1.4 Product Overview and Background

The glove itself may constitute a hazard. If allergens are released from the glove material they will be transferred to the body immediately due to tight skin contact with the glove, and the humid atmosphere inside the glove supports health effects. And hence before each use, gloves and sleeves should be inspected for holes; rips or tears.

This Surgical Gloves Testing Machine is the embedded software and mechanical controlled system for surgical gloves manufacturing industries. The aim of this system is to find pin and major holes of manufactured gloves automatically by the method of air pressure creation in gloves.

1.5 Design Goals

The aim of this system is to find pin holes and major holes of manufactured gloves automatically by the method of air pressure creation in gloves through air compressor and

measuring pressure depression in gloves with respect to time delay using pressure sensor. Depending up on air pressure changes (decrease) in the gloves system will decide good, bad and retest gloves with respect to predefined pressure thresholds, system will throw tested gloves to bins in different time delay to make separation of good, bad and retest.

This system will have sixteen modules which all modules will performa same gloves testing operation and each module will communicate to SCADA PC based software to configure gloves parameters like size, pressure threshold, air fill time, pressure test time etc. and production record.

This embedded system electronic parts consists of Microcontroller, Pressure sensor, Analog to digital converter, air solenoid valves, pneumatic actuators, rs232 communication media.

The system electrical and mechanical part of system is 24v power supply source to all 16 modules, ac 230/240v supply to motor and computer. Mechanical parts are gloves holder, all module placing compartments, and rectangular air container to supply air to individual gloves.

1.6 Definitions, Acronyms, and Abbreviations

PIC	Peripheral Interface controller
HLD	High Level Design
ADC	Analog to Digital Converter
UART	Universal Asynchronous Receive & Transmitter
GUI	Graphical User Interface
VCC	High voltage
LED	Light Emitting Diode
SCADA	Supervisory Control And Data Aquisition
PC	Personal Computer
USB	Universal Serial Bus
RISC	Reduced Instruction Set Code

1.7 Assumptions and Risks

The sensors need to be placed protected from extreme industrial conditions.

1.8 References

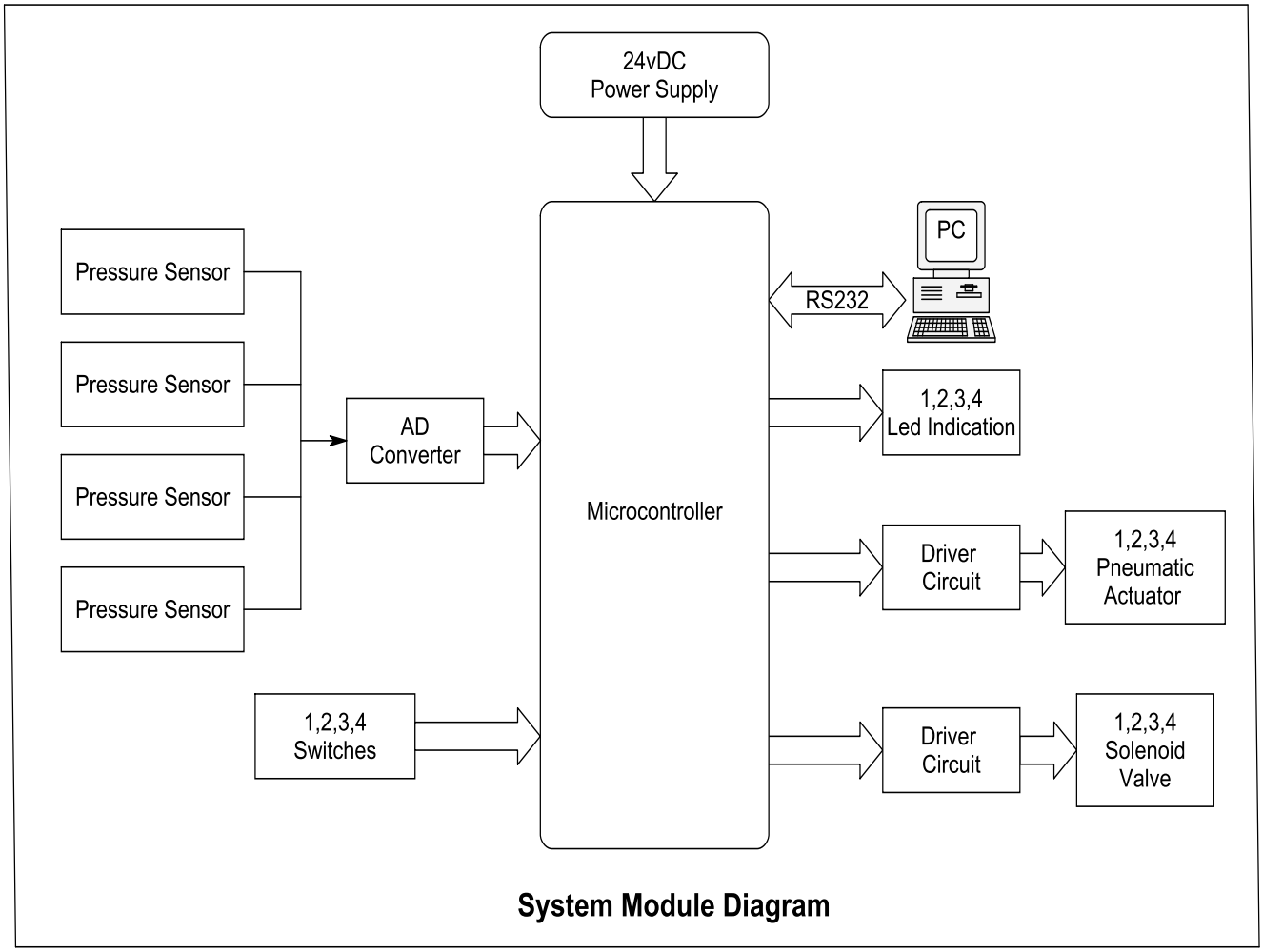
1) Datasheet – PIC18F4550.pdf

2) Datasheet – ADC1794.pdf

3) Datasheet – MAX232.pdf

2 Block Diagram

Figure shows the architecture of Surgical Gloves Testing Machine.



System Module Diagram

3 Module Description

As the Block diagram shows, there will be a pressure Sensors, pneumatic actuators

and solenoid volves, the pressure sensor sends the measured sensor data through ADC to Microcontroller. This value is processed to seperate the gloves into good, bad and retest. The air solenoid valve is used in the project to blow air into the gloves and the pneumatic actuators are used to control the air flow from solenoid valves.

Surgical Gloves Testing consists of the following major modules described below:

- **PIC18f4455**
- **Air solenoid valves**
- **Pneumatic Actuators**
- **24v Relays**
- **AD7794**

PIC18F4455

The PIC18F4455 incorporate a range of features that can significantly reduce power consumption during operation. Alternate Run Modes, multiple Idle Modes, On-the-Fly Mode Switching, Low Consumption in Modules are the key features for reduced power consumption. Enhanced Addressable USART is capable of standard RS-232 operation and provides support for the LINbus protocol. The TX/CK and RX/DT signals can be inverted, eliminating the need for inverting
buffers. Other enhancements include Automatic Baud Rate Detection and a 16-bit Baud Rate Generator for improved resolution.

10-Bit A/D Converter: This module incorporates programmable acquisition time, allowing for a channel to be selected and a conversion to be initiated, without waiting for a sampling period andthus, reducing code overhead.

PIC18F4455 used in the project controlls the overall sensordata aquisition process and communication to the PC(SCADA system). The PC is connected to the UART port of the microcontroller through DB9 connecter connected to MAX232 level translator IC which inturn is connected to the UART pins of the microcontroller.

The sensors are connected to the ADC channels of the PIC18F4455 the ADC converts the sensor data to digital signals which inturn is transmitted to the PC. The PC sends control signals to the microcontroller which in turn controls the peripherals.

Air Solenoid valves

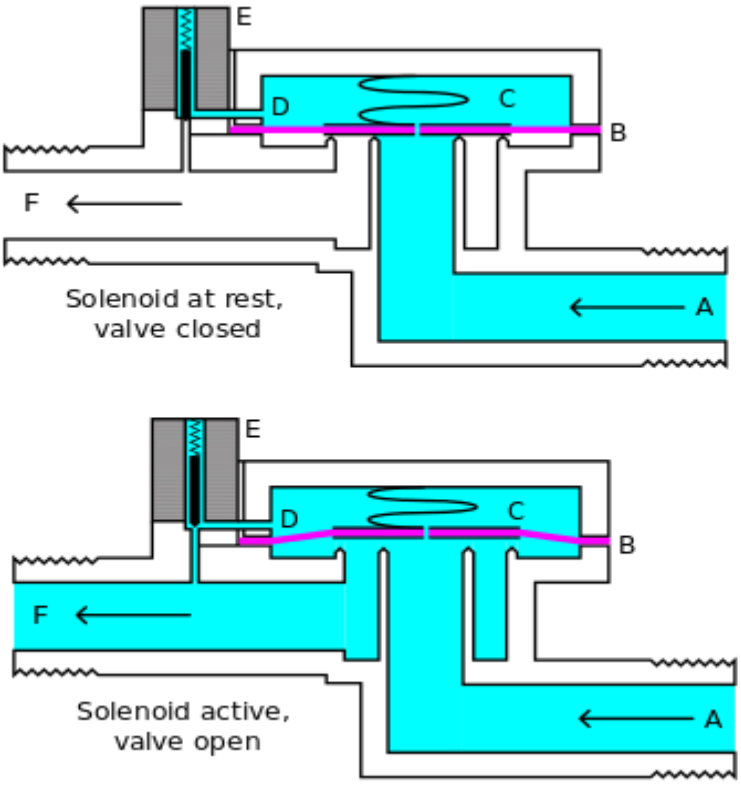
A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the

flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Air solenoid valves are used in the project for blowing air into the gloves for testing of tears or pin holes in the gloves. The preassure difference is noted once the air is blown to find the damaged products.

The figure below explains the working of solenoid valve. Air enters through A and B is an elastic diaphram, D is a drain passage closed by armature of solenoid E. When current is passed, the armature is withdrawn and water pushes the spring attached to spring and passes to F.



Pneumatic Actuators

A pneumatic actuator converts energy (typically in the form of compressed air) into mechanical motion. The motion can be rotary or linear, depending on the type of

actuator. A Pneumatic actuator mainly consists of a piston, a cylinder, and valves or ports. The piston is covered by a diaphragm, or seal, which keeps the air in the upper portion of the cylinder, allowing air pressure to force the diaphragm downward, moving the piston underneath, which in turn moves the valve stem, which is linked to the internal parts of theactuator. Pneumatic actuators may only have one spot for a signal input, top or bottom, depending on action required. Valves require little pressure to operate and usually double or triple the input force. The larger the size of the piston, the larger the output pressure can be.

24 Volt Relays

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. In the machine the solenoid valves and pneumatic actuators are all connected to microcontroller through 24 volt relays.

AD7794

The AD7794 is low power, low noise, complete analog front ends for high precision measurement applications. They contain a low noise, 24-/16-bit ∑-Δ ADC with six differential inputs. The on-chip low noise instrumentation amplifier means that signals of small amplitude can be interfaced directly to the ADC. Each device contains a precision, low noise, low drift internal band gap reference, and can also accept up to two external differential references. Other on-chip features include programmable excitation current sources, burnout currents, and a bias voltage generator that is used to set the commonmode voltage of a channel to AV DD /2. The low-side power switch can be used to power down bridge sensors between conversions, minimizing the system's power consumption. The AD7794 can operate with either an internal clock or an external clock. The output data rate from each part can vary from 4.17 Hz to 470 Hz.

The ADC7794 is used to take analog values from the pressure sensors. In the machine.

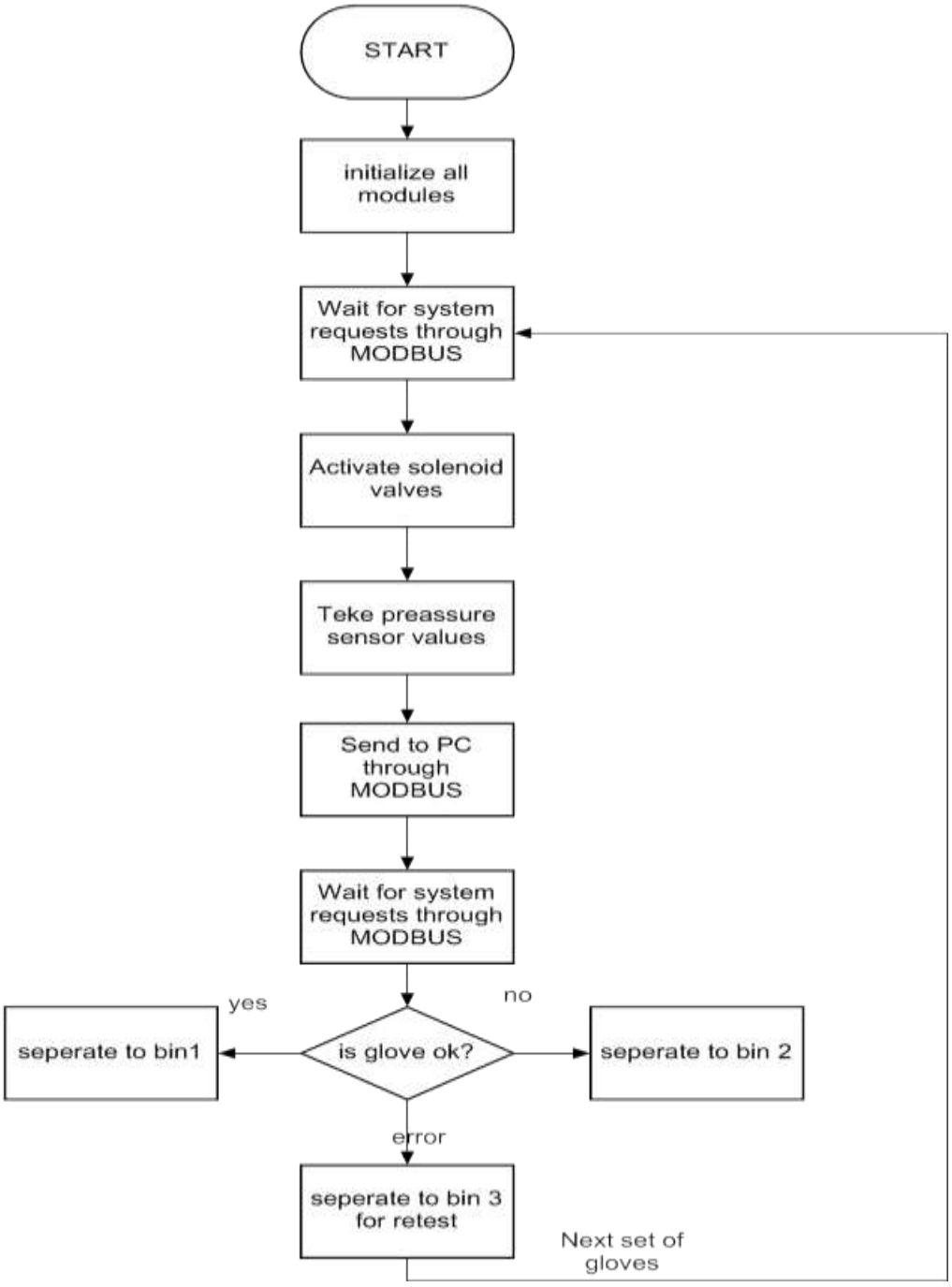
4 Communication Protocol

The protocol used for communication between PC and microcontroller is MODBUS

5 Graphical User Interface

The GUI is developed using MATLAB and it helps in monitoring the measured parameters.

6 Flow Chart for Program flow



7 Test and Debug

Test cases will be addressed in the test case documents and the debugging is done using MPLAB IDE uvision software tool.

8 Extensibility

The system can be extended to include more sensors for various other parameters also the system can be extended to test more gloves at a time.

9 Modifiability

The system features and the codes are modifiable.

10 Portability

Target Design Board and application software

11 Applications

1) The machine is specifically used for testing surgical gloves for pin holes or tears.
2) The same technology can be used for testing safety gloves or other gloves too.