Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

HSB
Hochschule Bremen
City University of Applied Sciences

Master 2016

Praveen Dara

Embedded distributed Human-Machine Application for Accelerator Based Metrology.

ABSTRACT - Masterthesis

High-end novel characterization approaches are essential to verify the correct fabrication of next generation micro-electronic components (E.g. sub-22 nm technology). In this framework accelerator based characterization is recognized as a versatile solution.

In this dissertation, an efficient software and system architecture has developed for the automation of an accelerator-based measurement system such as Rutherford Backscattering Spectrometry (RES). RES is used to determine the compositional analysis of thin films by measuring the backscattering of a beam of high energy ions impinging on a target sample.

The architecture is implemented as distributed to run from single or many computers. The objective is achieved by the development of a novel software architecture through the separation of the complex functionality into layers and independent device programs. The software modules are implemented using Visual studio - C/C++, HTML, JavaScript, Node.js, Batch programming and Gnuplot. In particular, the software communicate with various instruments through Ethernet (TCP/IP) and RS232/RS485 and with the user through a user-friendly graphical interface (GUI). The instrument driver software is enabled to work hidden in the background on user demand and thus helps to reduce the unintended user interaction.

The instruments used in this work are stepper motor drives which are used to keep the sample holder in a precise position with respect to the incoming ion beam. The data acquisition system which is used to store the backscattered energy of ions. A counter which is used to measure the charge that has fallen on the target sample.

Most of the communication between the software programs is done through communication files which comprises set of data exchange protocols. This approach allows to access the supervisory control application from various locations (locally and remotely) and by various users (multi-user). Exception handling, validation as well manipulation of input parameters, status reporting while in idle operation and while executing the commands are the features which makes the architecture reliable and robust. There are almost no limitations using the proposed approach as it is easy to

control more number of devices which provides to integrate other possible controlling tools, for instance pressure gauge and valve systems etc.

Last but not least, the architecture can be adapted to other (ion beam) analysis techniques such as Elastic Recoil and Detection Analysis (ERDA), Particle (or Proton) Induced X-ray Emission (PIXE), Nuclear Reaction Analysis (NRA), Medium Energy Spectroscopy (MES) and Low Energy Spectroscopy (LES) etc.