Design and Development of Microcontroller Based Data Acquisition Device for Electroluminescence and Mechanoluminescence Measurements

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Abstract

A lot of experimental research works on Mechano –and Electroluminescence materials is being done in opto-electronics laboratory of different departments of Postgraduate Studies and Research in Physics and electronics, in different universities in India. Observations are obtained manually. The present work, therefore proposes for high accuracy and high precision and high speed measurement of Electroluminescence and Mechanoluminescence with the help of ATmega16 and ATmega8 AVR microcontrollers, and the Light sensor (BPW34) is used, it is a PIN photodiodes with high speed and high radiant sensitivity in miniature, flat, top view, clear plastic package is used. It is sensitive to visible and near infrared radiation. It converts light in form of voltage. And dual low power operational Amplifier LM358 is used, LM358 consist of two independent, high gains, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltage.

KEYWORDS: - Data Acquisition, Luminescence Measurements, Light Interfacing, Converter.

1. INTRODUCTION -: Hardware and Software Interface plays an important role in co-design of the embedded computer system. It links the software part and the hardware part of the system. The design process supports software interface implementation and hardware interface synthesis. It is proposed to investigate how the hardware and software interfaces can be implemented by using bus extended technology in embedded computer system, which includes the primitive interface, the synchronous interface and the data communication protocol between the hardware and the software. The interfacing of computer is used in wide variety of research programs in different ways. The study of Mechano –and Electroluminescence have found application in large number of fields, electronics, warhead, computer, medical, space defense, radar, touch screen, sensor and switch based equipments. We need to have instrument or software to interface with the research results of Mechano-and Electroluminescence. It is essential to develop experimental setup with an objective of improving its accuracy and analyze to obtain measurement system which may not be available as a final product in the market. It is proposed to use such a system for measuring ML and EL output so that more accurate result can be obtained. A software interface may refer to a range of different types of interface at different "levels": An operating system may interface with pieces of hardware, applications or programs running on the operating system may need to interact via streams, and in object oriented programs, objects within an application may need to interact via methods. A piece of software provides access to computer resources (such as

memory, CPU, storage, etc.) by its underlying computer system; the availability of these resources to other software can have major ramifications—sometimes disastrous ones—for its functionality and stability.

2. Hardware Design

2.1 Description of Main Component: - Most modern MCU including AVRs has an ADC on chip. An ADC converts an input voltage into a number. An ADC has a resolution. A 10 Bit ADC has a range of 0-1023. (2^{10}=1024), The ADC also has a Reference voltage (ARef). When input voltage is GND the output is 0 and when input voltage is equal to ARef the output is 1023. So the input range is 0-ARef and digital output is 0-1023. Now you know the basics of ADC let us see how we can use the inbuilt ADC of AVR MCU. The ADC is multiplexed with PORTA that means the ADC channels are shared with PORTA. The ADC can be operated in single conversion and free running more. In single conversion mode the ADC does the conversion and then stop. While in free it is continuously converting. It does a conversion and then start next conversion immediately after that.

The ADC needs a clock pulse to do its conversion. This clock generated by system clock by dividing it to get smaller frequency. The ADC requires a frequency between 50 KHz to 200 KHz. At higher frequency the conversion is fast while a lower frequency the conversion is more accurate. As the system frequency can be set to any value by the user. So the Prescaler is provided to produces acceptable frequency for ADC from any system clock frequency. System clock can be divided by 2, 4, 16, 32, 64, 128, by setting the Prescaler. The ADC in ATmega16 has 8 channels that mean you can take samples from eight different terminals. You can connect up to 8 different sensors and get their values separately.

2.2 Circuit Design: - hardware circuit deign can we divided into six main parts: BPW34 Sensor, LM358 Operational Amplifier, used as Voltage buffer, ATmega16 Microcontroller, ATmega8 Microcontroller, Serial to USB Converter and, USB of PC/Lap Top as shown in figure1, Light Sensor (BPW34) is convert the luminescence light in form of voltage and it is connected with the LM358 operational Amplifier with pin number 3 and VCC, the output of the operation amplifier is connected with Port A, of ATmega16 microcontroller (with ADC0), in ATmega16, PORTA is programmed as a input port and it accept the input from the LM358 operational Amplifier, and PORTD is programmed as a output port (PD0, PD1) and it is connected to the ATmega8 PORTD pin no. 2 and 3 (PD0, PD1), A 16 Mega hertz Crystal is connected with Pin no. 12 and 13 of ATmega16 microcontroller to provide the frequency. A 12 Mega Hertz Crystal is connected with ATmega8 Microcontroller with pin number 9 and 10. The ATmega16 convert the data and provide the data at USB Port at Pin number 4 and 5. As shown in figure 2.

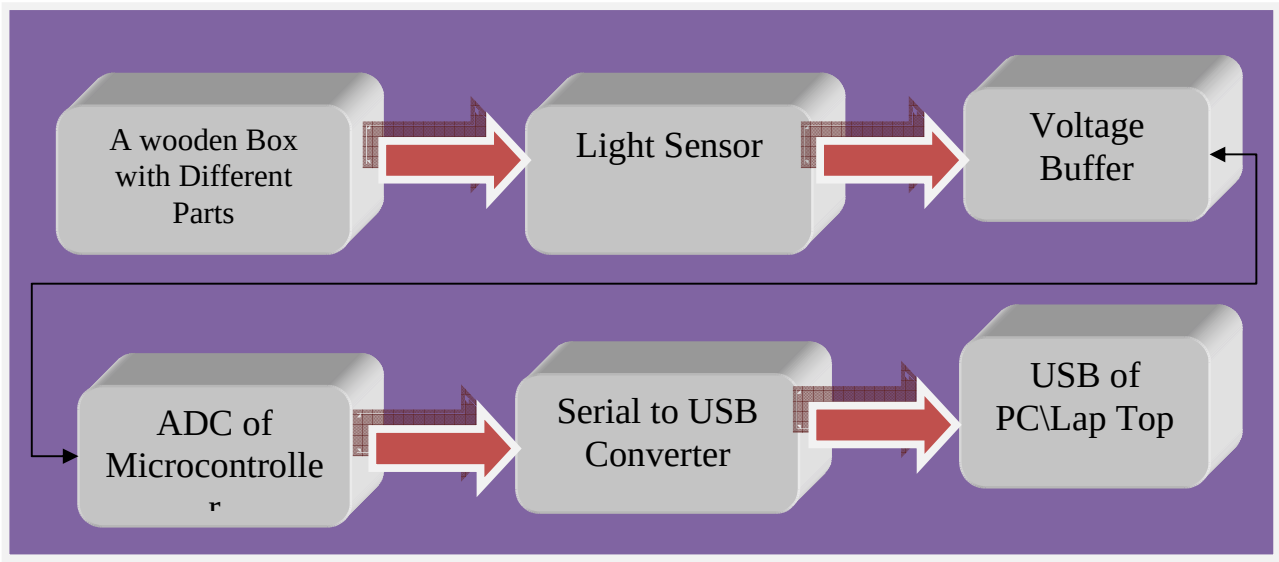

Figure 1. Bloc Diagram of DAQ Device.

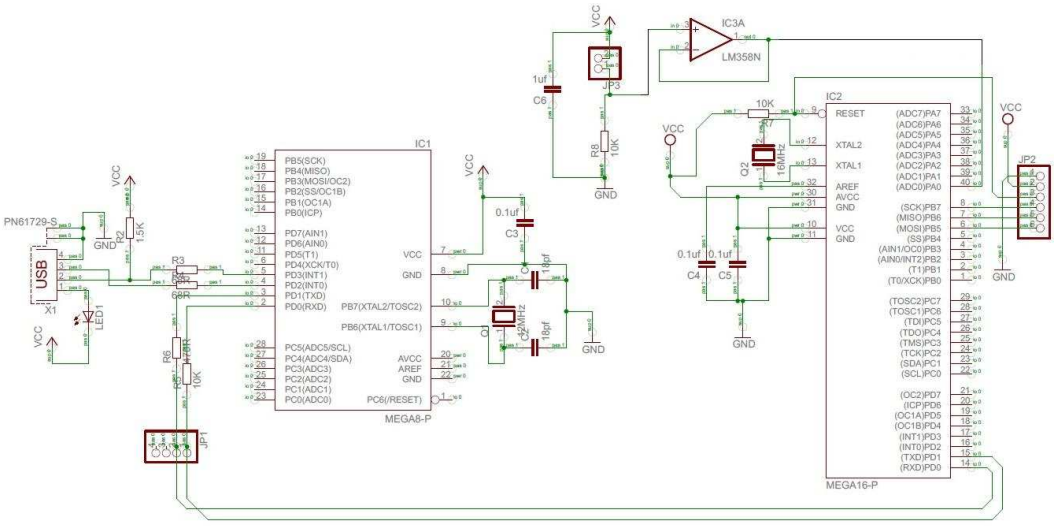

Figure 2. Schematic of the Data acquisition System

3. Verification and Results:- When Electroluminescence cell is Excited by high voltage and frequency, it emits lights and When light fall on sensor it convert light into voltage and apply to microcontroller ATmega16 and processed to further stage of ATmega8 microcontroller and it convert to data for USB Port and data are read from USB Port by VB.net Software and data are processed and display on the Monitor and data are Compare with different voltage and different Frequency at different time. Similarly in Mechanoluminescence when load is applied on phosphor or drop a load from particular height phosphor emit light and this phenomena is called Mechanoluminescence and emitted light is fall on Sensor it convert and processed by ATmega16 and ATmega8

Microcontroller and data convert and reached at USB Port and data are read at USB by VB.net Software which is design and developed for the particular Application

4. Conclusion: - interfacing results of Mechanoluminescence are shown in figure 3. As given below.

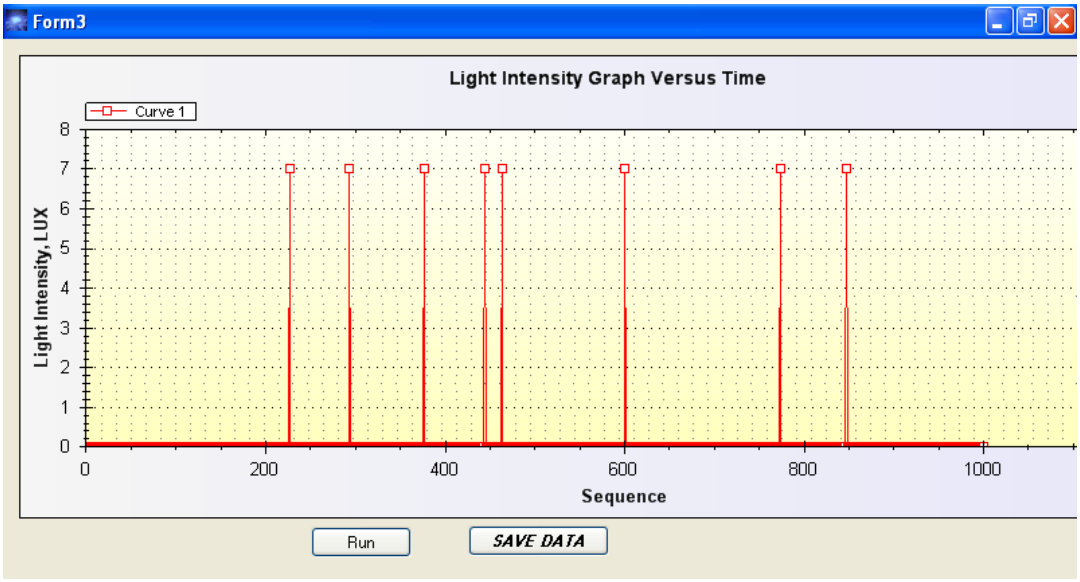

Figure 3. Interfacing result of Luminescence Light versus Time.

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