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REVIEW ON IMPLEMENTATION OF ANALOG CIRCUITS USING EXPEYES TOOL

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***Abstract*— ExpEYES stands for Experiments for Young Engineers and Scientists. ExpEYES is an open source platform for performing the experiments. Implementation of analog circuits can be performed by using ExpEYES hardware. It is a low cost and small size device which replace dedicated instruments like function generator, CRO, multimeter and power supply. The simple and open architecture of ExpEYES allows us to develop new experiments, without getting into the details of electronics or computer programming. In this paper, we studied software installation, basic GUI program, implementation of analog circuits with active devices; observe the waveforms and measuring the performance parameters.**

Keywords—**ExpEYES, ExpEYES Junior, GUI, PHOENIX, Raspberry pi.**

I. INTRODUCTION

ExpEYES hardware features like measuring voltage and frequency, setting voltage and frequency and measuring time intervals. Functions for accessing these features are available in python and C language [1]. Experiments can be performed by using dedicated instruments like measuring voltage, velocity, temperature, pressure and humidity etc., so it becomes costly. Therefore, ExpEYES hardware is used [2].

In 2005, PHOENIX project was started, with aim of developing cost effective experiments. It consists of parallel port device, controller element, device driver and code was written in C language. In 2006, the small size device with microcontroller and RS232 option for communication between them after that USB is used and code was written in python programming language. In 2011, the device is fully USB powered and 12 bit ADC was used for getting high bit resolution. In 2012, the device is small in size, USB powered and cost effective [2]. ExpEYES is a low cost small size device that can generate or measure the voltage as a function of time and generate the graphs. It performs function like CRO, function generator, multimeter and power supply to perform the experiments. By using ExpEYES, we can reduce the cost of dedicated instruments. It is portable device because it is used at anywhere and anytime.

The main objective of this paper is to study block diagram of ExpEYES design, interconnection among sensors and microcontroller, understanding Python library and finally develop a low cost device which performs the all experiments for lab practice.

The outline of the paper is given as: Section I describes evolution and basic information of ExpEYES tool. Section II explains relevant work towards design and implementation of electronic circuits using this tool. After that our proposed work mention in Section III. Finally, paper is concluded in Section IV.

II. LITERATURE SURVEY

This idea is initiated in 2005 and then it is being followed in many of following research articles. Few of them are directly relevant to our proposed work which is explained below:

Trilochan Patra performed an experiment of optical displacement sensors by using ExpEYES junior kit. Phototransistor converts the optical signal into electrical signal. LED is used to emit the light which falls on phototransistor. ExpEYES kit is used for interfacing. If the intensity of light can be changed then the output of the phototransistor is changed and it is displayed on GUI. Optical fiber is media between phototransistor and LED [3].

Melvin Chelli et. al. developed open source controllers for controlling the speed of DC motor without affecting performance. This controller mainly consists of signal processing unit and power processing unit. ExpEYES is open source platform and python programmable is used for closed loop speed control of DC motor. ExpEYES junior is used to generate high frequency variable PWM to control a DC motor [4].

Authors in paper [5] designed an Audio Frequency Analyzer Using ExpEYES and Raspberry pi which work on low cost frequency analyzer for audio signals as an input. Raspberry pi is heart of the frequency analyzer. Audio data is received at ExpEYES and it is connected to the raspberry pi. The output of Fourier Transform and displaying GUI of raspberry pi monitor is used.

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III. PROPOSED WORK

The block diagram of proposed work is shown in Fig. 1. This system uses dedicated ExpEYES hardware instead of traditional instruments for lab practices. The novel approach is to implement the system using Raspberry Pi instead of traditional microprocessor.

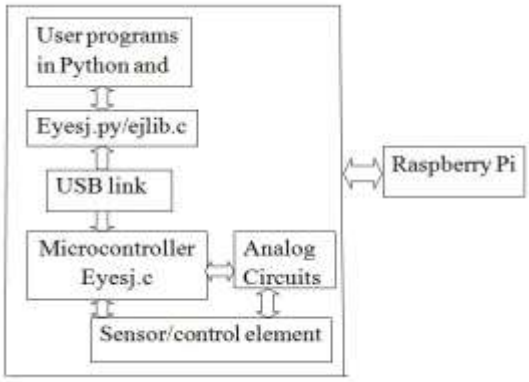


Fig. 1. Block Diagram of Proposed Work

The sensor or control elements are connected to the microcontroller. The user program uses the Python Library to communicate to the microcontroller, running a program, written in C and Assembler. The microcontroller performs the control or measurement operations and sends the result back to the PC. The job is divided according to the capabilities and strong points of each device. The microcontroller does all the real time measurements and passes on the results to the PC where Python code for processing and displaying the data.

A. Experimental Setup

The analog circuit is implemented on breadboard and connected to the ExpEYES as an input and display the output waveforms on GUI. The circuit set up is shown in Fig. 2.

The main GUI of ExpEYES is shown in Fig. 3 which is 4-channel Digital Storage Oscilloscope, with several extra functions. An oscilloscope displays voltage as a function of time and it is a very useful tool for to study electrical and electronic circuits.

Analog circuits which can be perform as follows:

1. RC circuit
2. RL circuit
3. RLC circuit
4. FET based circuits
5. Op-amp based circuits
6. Instrumentation amplifier

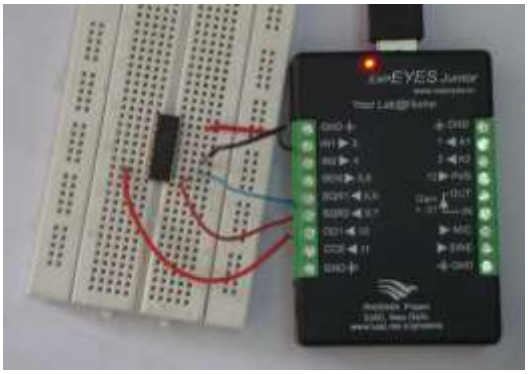


Fig. 2. Interconnection of Circuit with ExpEYES

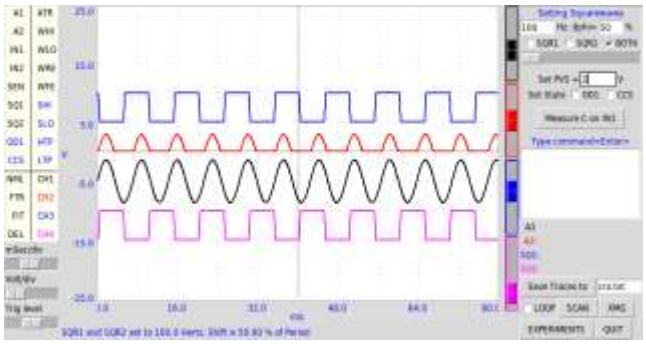


Fig. 3. GUI of ExpEYES Hardware

B. Programming

ExpEYES software is written in Python and it should run on any computer having Python interpreter and Python Serial library. Since the programs are written in Python, the same source code works on GNU/Linux and Windows. Python Interpreter and the required libraries must be installed in system.

The USB device appears as an RS232 connection to the software. The virtual COM port is established by the driver software for the USB to Serial converter MCP2200.

MicroHOPE is a micro-controller development system based on Atmel ATmega32. To code in assembler, one should have some idea about the architecture of the target hardware. It is enough to assume that the AVR micro-controller appears to the programmer as a set of General Purpose Registers (GPRs: R1 to R31), Special Functions Registers (SFRs) that controls the peripherals, some data memory (2kbytes of SRAM for Atmega32). All of them are in the data address space. We also have Program memory and EEPROM in different address spaces.

Assembly language programming involves moving data between GPRs, SFRs and RAM, and performing arithmetic and logical operations on the data.

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C. Output of common analog circuits

The non-linear elements like diodes and transistors are studied by drawing their characteristic curves as shown in Fig. 4, 5, 6 & 7 and making simple circuits to demonstrate their functioning.

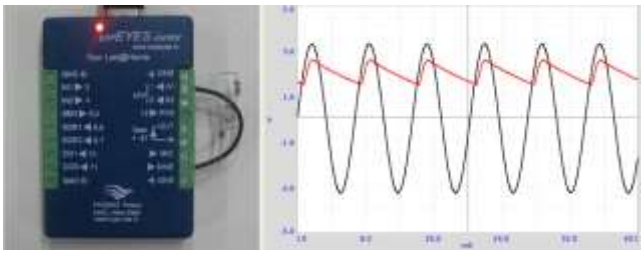


Fig. 4. Working of HWR with waveforms

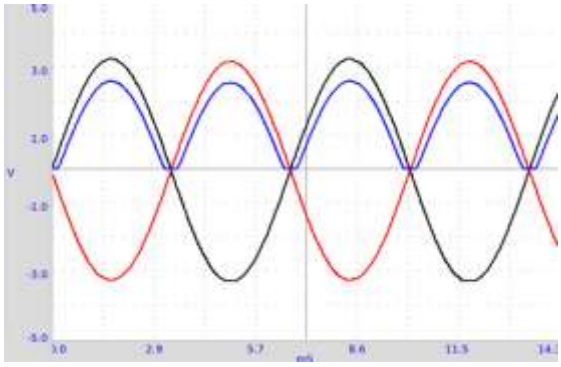


Fig. 5. Waveforms of Full Wave Rectifier

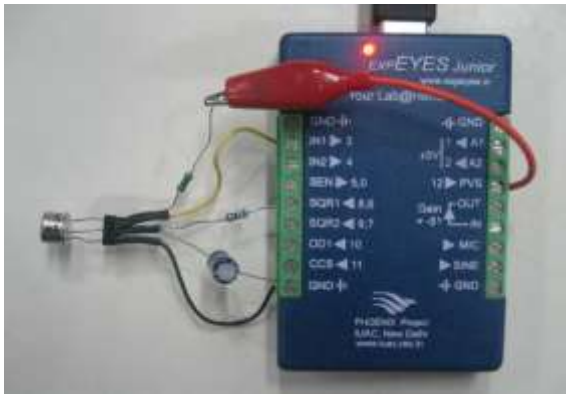


Fig. 6. BJT CE Configuration with ExpEYES

IV. CONCLUSION

ExpEYES is a system that is low cost and small size which performs all experiments of engineering and science. The advantage of ExpEYES is portable. It performs real time applications to measure voltages and generate graphs. ExpEYES is the tool for learning by exploring and experimenting. The tool is open hardware and free software. But it has certain limitations like it is used only for 50 GUI experiments. The measurements are accurate with good resolution. It also gives high sensitivity towards change in input and output signals.

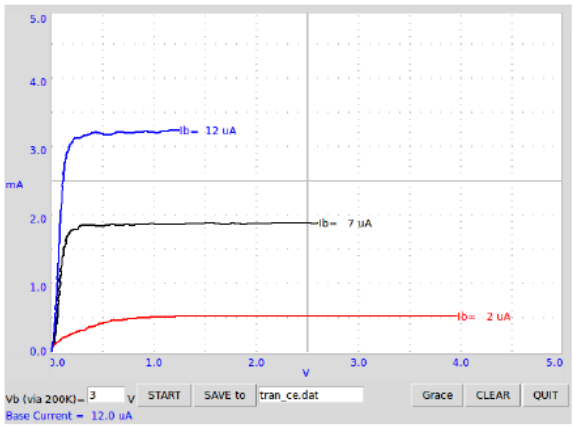


Fig. 7. V-I Characteristics of BJT CE Configuration

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