

# A Case Study with Virtual Lab on Electrical Engineering Experiments

C Sunanda<sup>1\*</sup>, Hemalatha J N<sup>1</sup>, Trilokchandran<sup>2</sup>

<sup>1</sup>Department of EEE, RV College of Engineering®, Bengaluru-560059

<sup>2</sup>Assistant Professor, Department of Biotechnology, RV College of Engineering®, Bengaluru-560059

## Abstract

Current technologies lend the ability to enhance and replace traditional laboratory classes with computer-based resources, often called virtual labs. This paper presents a pilot study of virtual lab implemented on electrical engineering experiments. The experiment was aimed at studying the speed control of slip ring induction motor using virtual lab platform developed by IITs. Effectiveness of virtual lab was assessed based on a feedback survey of the students participated. The results of the survey indicated effective learning.

**Keywords:** *virtual lab, e-learning, feed-back survey*

## 1.0 Introduction

Professional courses emphasise learning by doing and traditional methods of implementing laboratory classes are cost intensive and demand physical presence of the teacher and the students [1-2]. Through Information and Communication Technology (ICT) the Ministry of Education, Government of India initiated Virtual labs project during the pandemic under the National Mission on Education. Students of different branches of Science and Engineering got access to perform experiments virtually in this platform. Virtual Labs platform is a major initiative by the Indian Institute of Technology (IITs) for students all over the world [3-4]. The open-source platform is mainly a substitute for offline labs. Even though the simulation is moderately accurate, it gives an idea of the working of the systems. The labs under different engineering domains are well structured with detailed explanation of relevant theory, simulation procedure for performing experiment, tabulation of results and quiz questions to assess the level of understanding of the concepts [5-6].

Virtual Labs can deepen the understanding of the theoretical and practical concepts and hence improve the quality of learning, especially in professional courses [7-10]. Virtual labs serves as preparatory phase

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\*Mail address: C Sunanda, Assistant Professor, Department of EEE, RV College of Engineering®, Mysore Road, Bengaluru - 560059, Karnataka, India, Email: sunandac@rvce.edu.in , Ph: 9844436428

before attending physical lab sessions. It helps them to deeply understand the theoretical concepts, operational details, safety issues, interpretation of results, applicability of the experimental results and their validation, wherever possible. Thus, it is helpful to compress the physical lab schedules and de-densify laboratory space which is a growing requirements due to the pandemic [11-12]. Virtual labs can also help increasing the enrolment without expanding the existing laboratory space and infrastructure. Online education is expanded to many domains including professional programmes. Virtual labs can effectively integrate and balance offline and online modes of learning. Virtual labs offer disruptive means of learning for next generation education in engineering through curriculum enrichment with cutting edge technologies. The course content becomes effective, scalable and flexible with the introduction of virtual labs [13-15]. This paper is a pilot study on the learning effectiveness of electrical engineering laboratory experiment through Virtual lab platform.

## 2.0 Case Study

The usage of virtual lab platform developed by MHRD in Electrical domain for different semesters was considered and some of the experiments were conducted as virtual lab. One experiment titled ‘Speed control of Slipping Induction Motor’ of Electrical Machines lab was conducted for the case study. Fig. 1 shows the schematic circuit of the experiment.

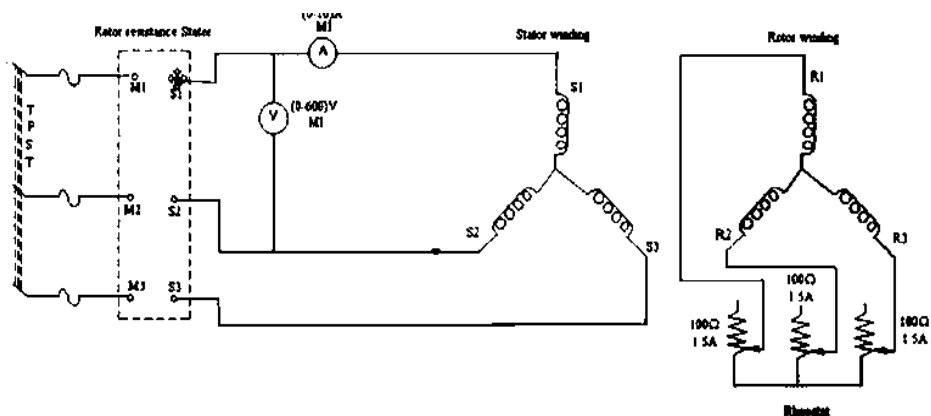


Fig. 1. Schematic Circuit diagram of slipping induction motor

The objective of the experiment was to control the speed of the induction motor by varying rotor resistance. The layout depicting connection layout before conduction of the experiment is shown in Fig. 2.

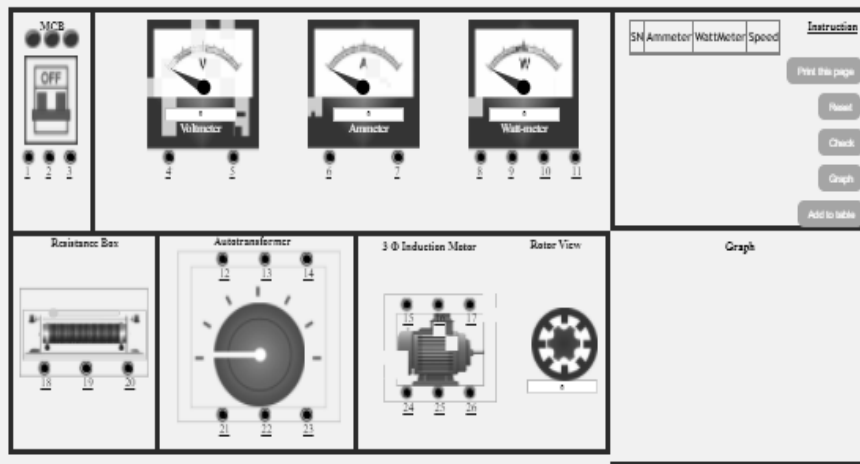


Fig. 2. Connection Layout before connecting the wires

Detailed connection procedure was explained to the students and they performed the wire connections as per the hardware circuit diagram. The editor can make proper connections in case of mistakes through an error message. After ensuring the connections right, simulation was invoked by switching MCB on, varying resistors and noting meter reading for every step. Fig 3 shows the results. All the steps were performed according to the off line lab procedure so that the students get experience of conducting lab virtually.

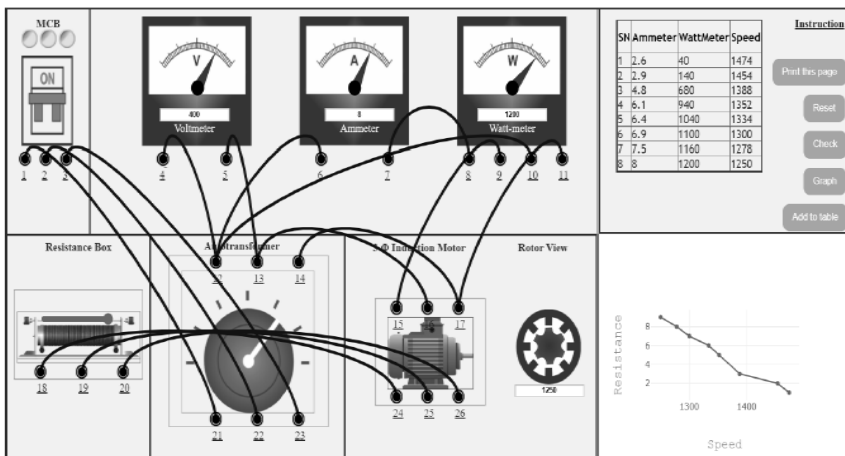


Fig. 3. Connection diagram with results after making connection

In the similar way demonstration was given to students by the faculty to conduct experiments in other courses. The same experiments were

conducted in the lab by the teachers and recorded video was circulated to the students for better understanding.

### 3.0 Survey Results

The students were trained on virtual lab along with download facility of Virtual lab. Assignments were given to practise. A questionnaire was circulated and the feedback was analyzed. Responses were given by 32 students (Fig. 4). Questions were asked on ease of access, responsiveness of the website, structure of the lab exercise and adequacy of the information given. The survey indicated that the lab was effective and suggested inclusion of virtual lab in regular curriculum.

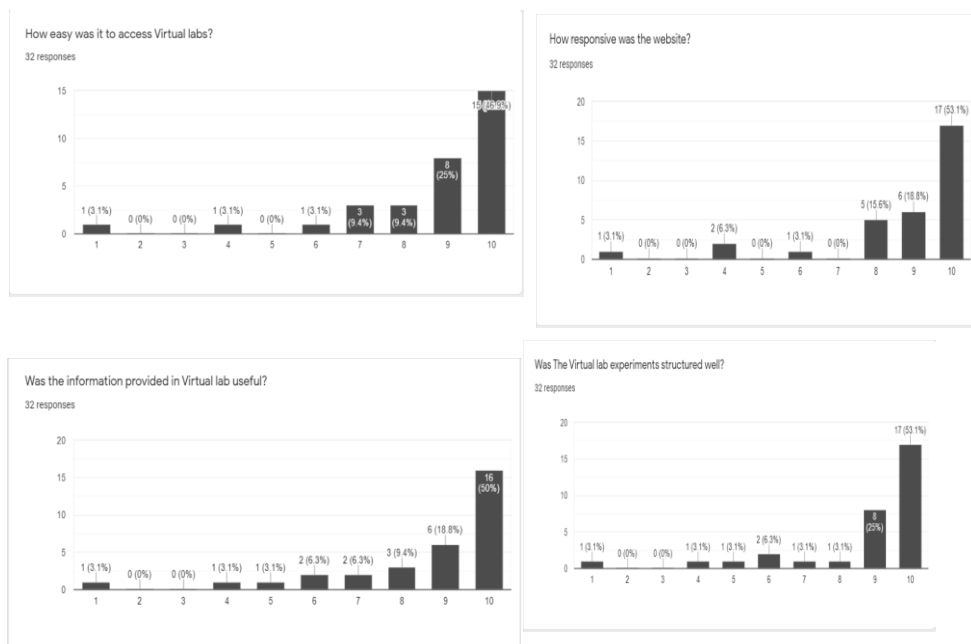


Fig. 4. Results of the survey

### 4.0 Conclusion

The pilot study on Virtual lab implementation was implemented on an experiment titled Speed Control of Slipring Induction Motor, which is part of Electrical Machine Lab course, in Virtual lab platform. A survey was conducted and the students were asked about their learning experience through virtual lab. Majority of the students expressed that their learning was effective. Virtual lab can be introduced in the curriculum for enrichment.

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