

HO CHI MINH UNIVERSITY OF TECHNOLOGY OFFICE FOR INTERNATION STUDY PROGRAM DEPARTMENT OF AUTOMOTIVE ENGINEERING



DESIGN A MEASURING SYSTEM AND METHOD FOR MEASURING

THE SPEED OF AN ALTERNATOR

Student: Nguyễn Quốc Kiệt ID: 1952802

Instructor: Ph.D Trần Đăng Long

1. General information about alternator:

The alternator is a 3-phase synchronous generator.

Phase voltage is the voltage measured across a single component in a three-phase source or load.

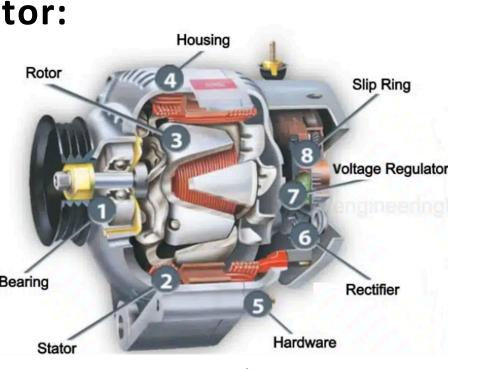


Figure 1. Alternator

2. The relationship between alternator speed and frequency:

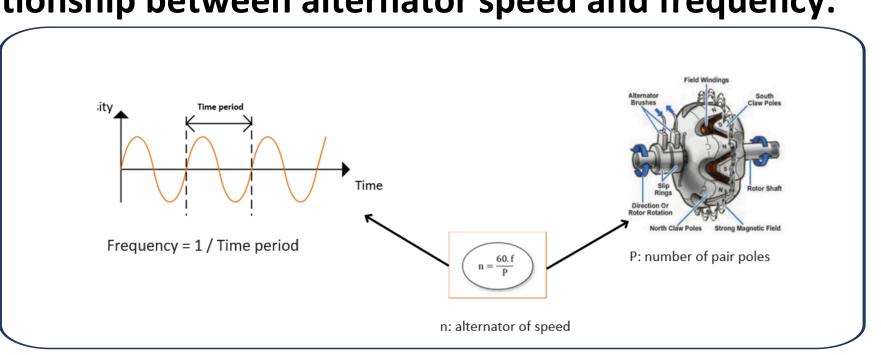


Figure 2. Formula to calculate the Speed of Three-Phase Synchronous Generator

. INTRODUCTION

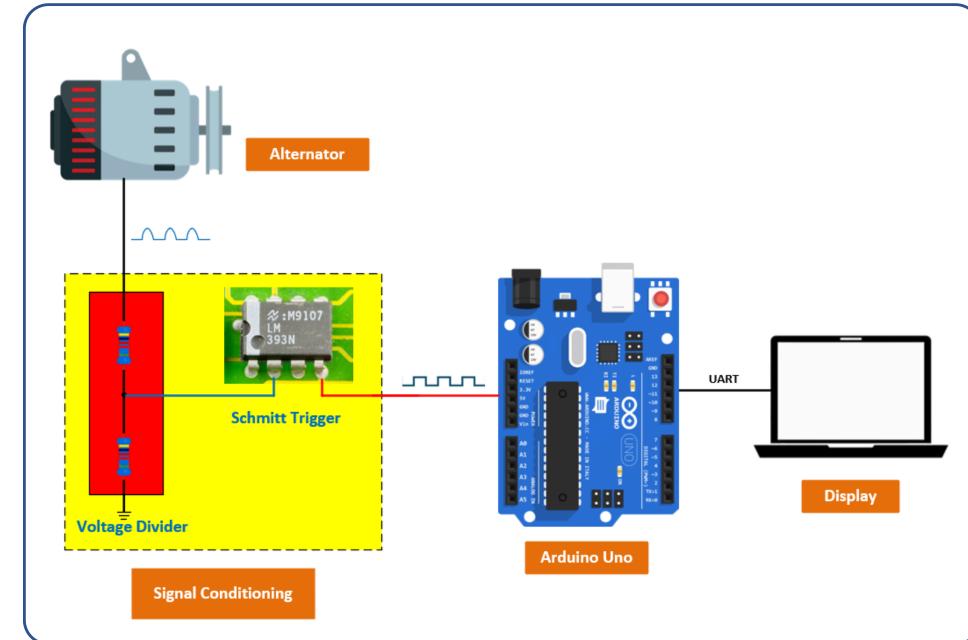
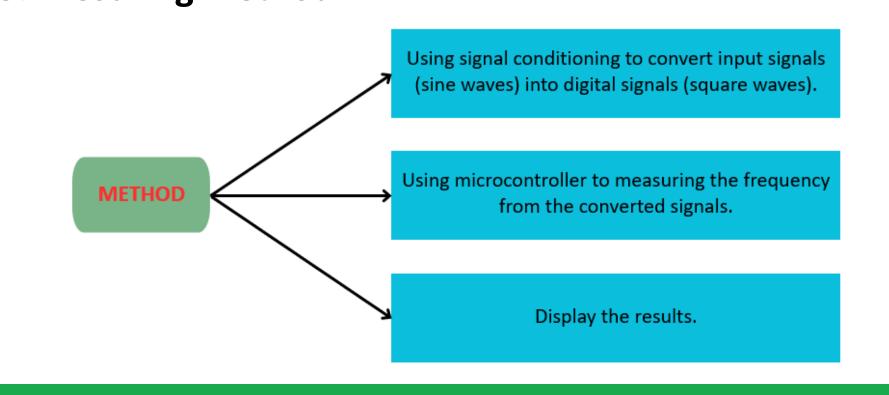


Figure 3. General layout diagram

3. Mesuring method



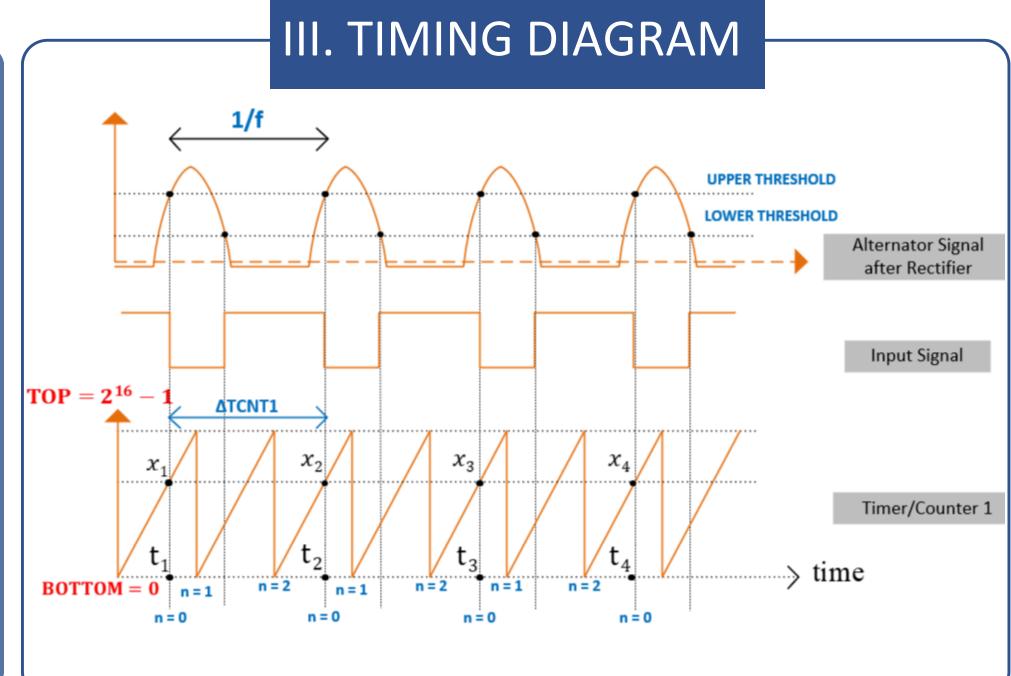
- Objectives: Design a measuring system and method for measuring the speed of an alternator. The system is designed to accurately measure important parameters including frequency and operating speed of the alternator.
- System requirements:

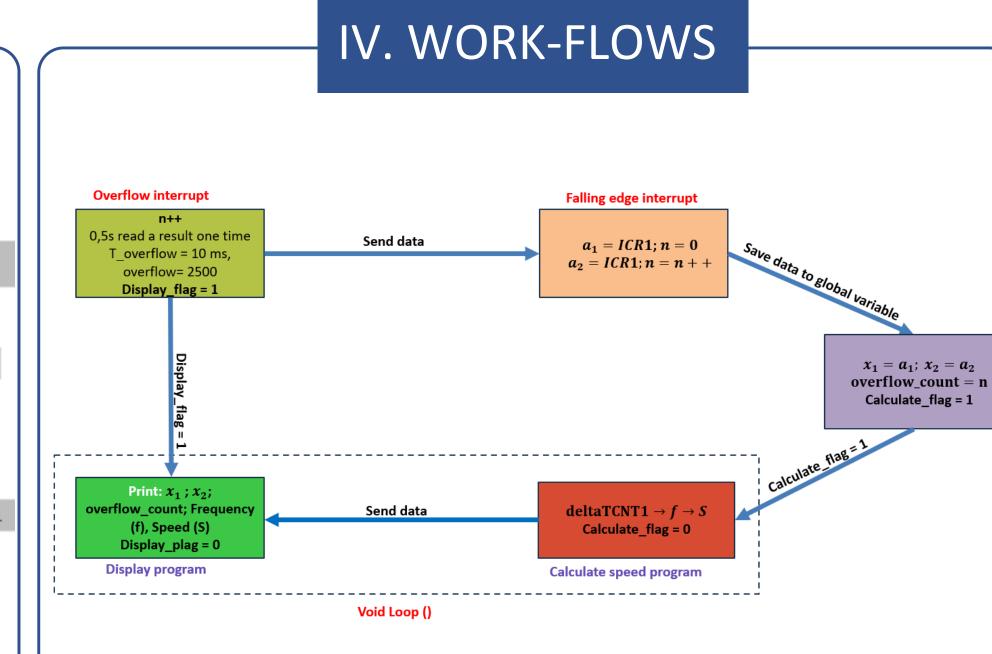
VII. SIMULATION AND RESULTS

Digital Oscilloscope

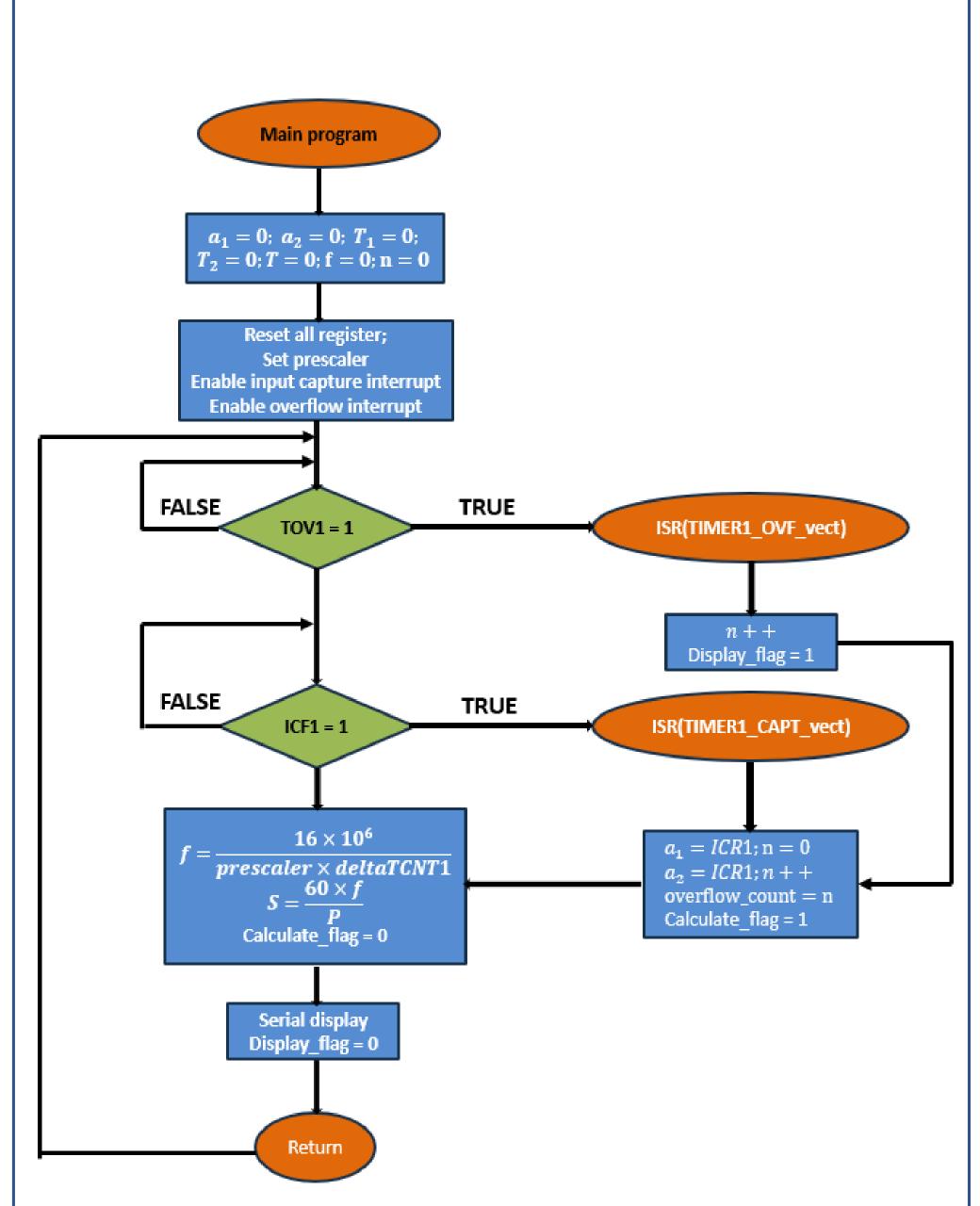
- Measurement: error less than 5%
- Measuring range: 500 15000 RPM.
- Graphical User Interface: clear and user-friendly.

Alternator V_{in} = 14V V_{out} = 5V V_{out} = 5V Voltage Divider Signal Conditioning



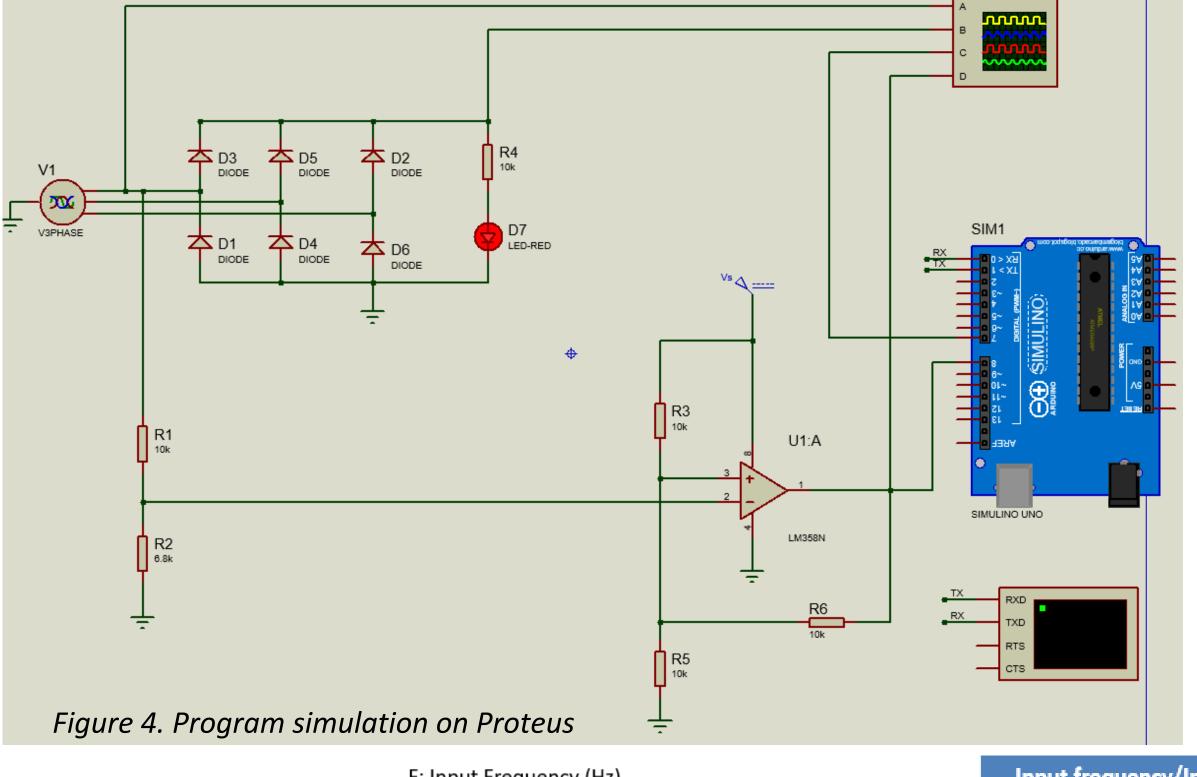


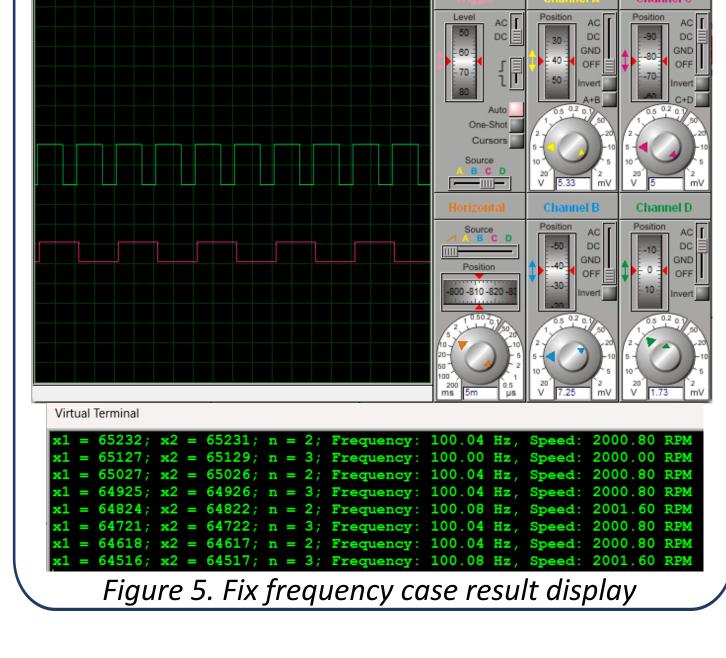
V. ALGORITHMS



√ Display information clearly and accurately







F: Input Frequency (Hz). $V=\frac{60\times F}{P} \text{ (RPM), P = 3: number of pole pairs}$ $F_1\text{: measured frequency in fixed case}$ $V_1=\frac{60\times F_1}{P} \text{ (RPM)}$

 Input frequency/Input
 Real-time Frequency

 Speed (F/S)
 Result display (F_1/S_1) Error %Δ1

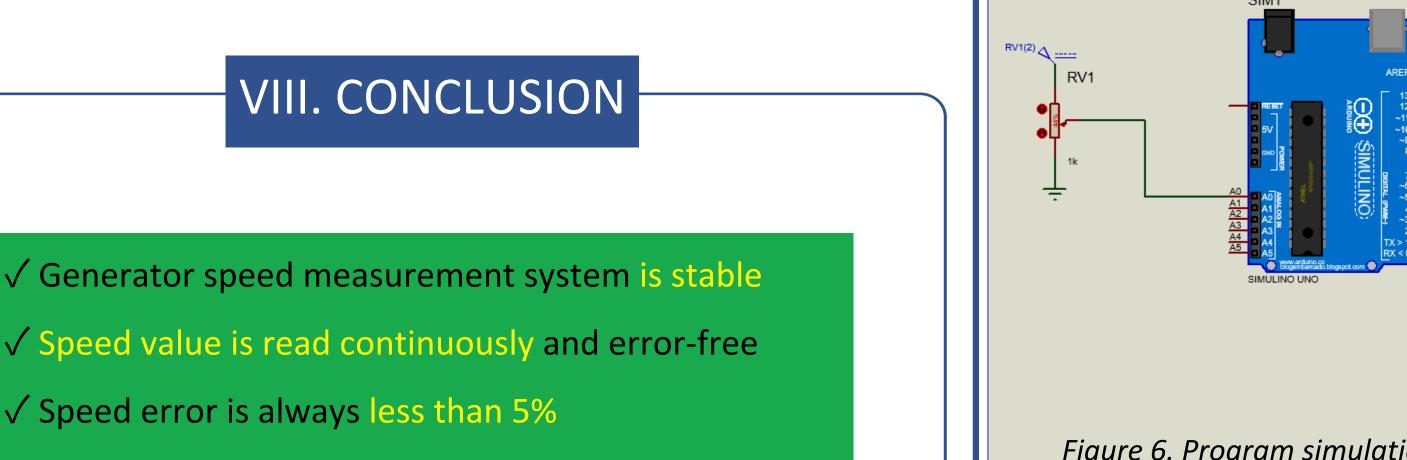
 100/2000
 100.04/2000.80
 0.04 %

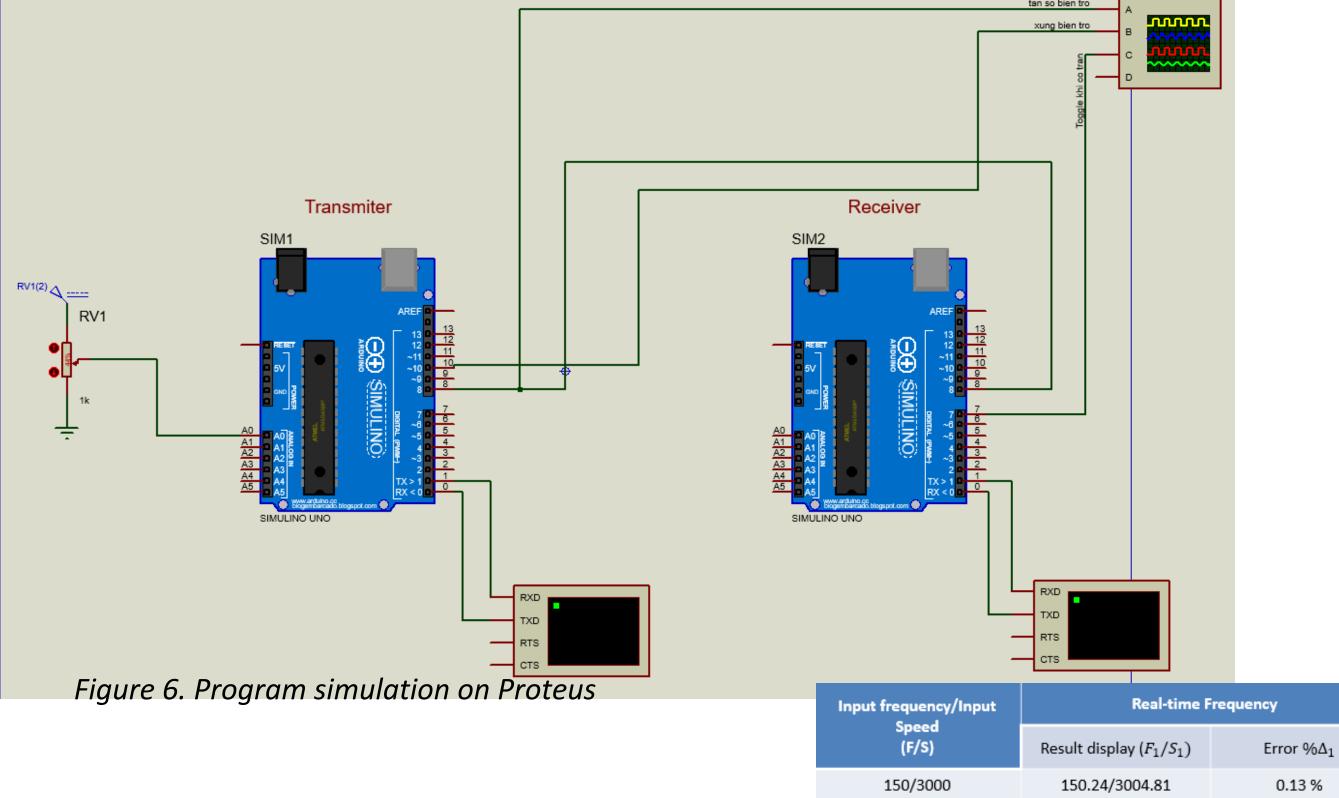
 120/2400
 120.02/2400.38
 0.02 %

 150/2600
 150.06/3001.20
 0.04 %

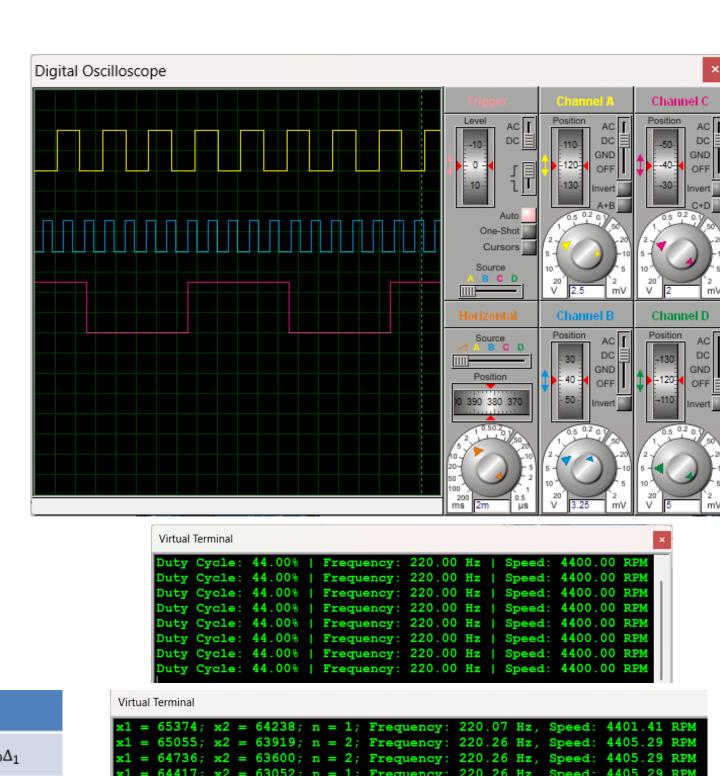
2. Real-time frequency case:

Table. Results for the fixed frequency case show errors





 $\%\Delta_1 = \frac{|F_1 - F|}{F}$: error when measuring in fixed case



. = 65411; x2 = 64275; n = 1; Frequency: 220.07 Hz, Speed: 4401.41 RPM

Figure 7. Real-time frequency case result display

Table. Results for the real-time frequency case show errors

220.07/4401.41

300.12/6002.40

220/4400

300/6000

0.03 %

0.04 %