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Analysis of Power Quality Disturbances in Power Systems

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ABSTRACT: This paper shows MATLAB/SIMULINK models, which cause various disturbances in power quality of a power system. The distribution fault occurring in a line, starting of induction motor, energizing of transformer, switching of capacitor banks, Impulse due to lightning, Single-phase and Three phase Non-Linear Loads and Electric Arc Furnace are some the examples which cause power quality disturbance in power systems. Various power quality disturbances are simulated, which are frequently used for power quality analysis research.

KEYWORDS: Power Quality, Voltage sag, Line fault model, Induction motor starting, PQ Analysis
.

I.INTRODUCTION

Power quality has a significant role to play in power engineering, as it is ensuring power quality to the consumer. The recent inception with grids of smart technology apprehends the significance of quality of power. Industries lose millions every year throughout the world due to these disturbances affecting the power quality. Research in the field of power quality enables a researcher to study various causes leading to disturbance in power quality and also motivates the same to develop various strategies to mitigate it. This will also lead a researcher to thrive for perfect methodology for mitigation of issues in power quality and helps to find the root cause of phenomenon. In this fast-growing technology era, simulation of disturbance in power quality is quite possible task. This makes the job of tracing, analyzing and understanding the principal cause of disturbance in power quality effortless and uncomplicated, giving a researcher the intuition about the propagation of power quality disturbance in a complicated power system. Power system simulation tools are now-a-days very prominently used in analysis of power system.

II.MODELLING APPROACH & SIMULATION RESULTS

It considers a network with N mobile unlicensed nodes that move in an environment according to some stochastic mobility models. It also assumes that entire spectrum is divided into number of M non-overlapping orthogonal channels having different bandwidth. The access to each licensed channel is regulated by fixed duration time slots. Slot timing is assumed to be broadcast by the primary system. Before transmitting its message, each transmitter node, which is a node with the message, first selects a path node and a frequency channel to copy the message. After the path and channel selection, the transmitter node negotiates and handshakes with its path node and declares the selected channel frequency to the path. The communication needed for this coordination is assumed to be accomplished by a fixed length frequency hopping sequence (FHS) that is composed of K distinct licensed channels. In each time slot, each node consecutively hops on FHS within a given order to transmit and receive a coordination packet. The aim of coordination packet that is generated by a node with message is to inform its path about the frequency channel decided for the message copying.

Various disturbances in the quality of Power system are modelled using the popular tool MATLAB/SIMULINK and waveforms are observed.

Model of Power quality disturbance due to fault in line:

The power quality disturbance due to fault in line model which is simulated as shown in Figure 1. This model consists of 33 kV, 50 MVA, 50 Hz, three-phase source feeding 33 kV/11 kV, 5 MVA delta/wye transformers to a 50kW resistive and 150kVAR inductive load.

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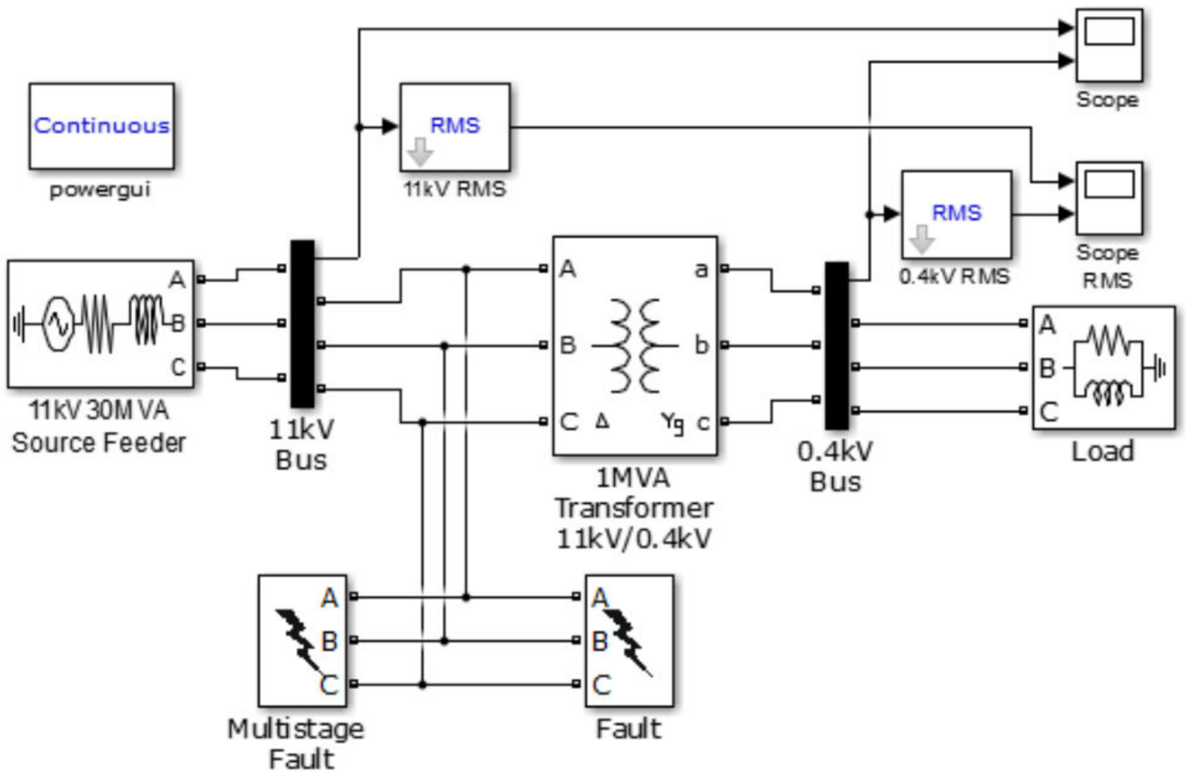

Fig. 1: Power Quality Disturbance due to line fault

This model has the capability to simulate various faults in power system. Figure-2 depicts voltage sag waveforms at 33kV feeder, due to line-to-line fault between phases A and B. It clearly shows that 33kV bus has experienced different sag magnitudes at phases A and B. This is due to high resistance existing two faulted lines.

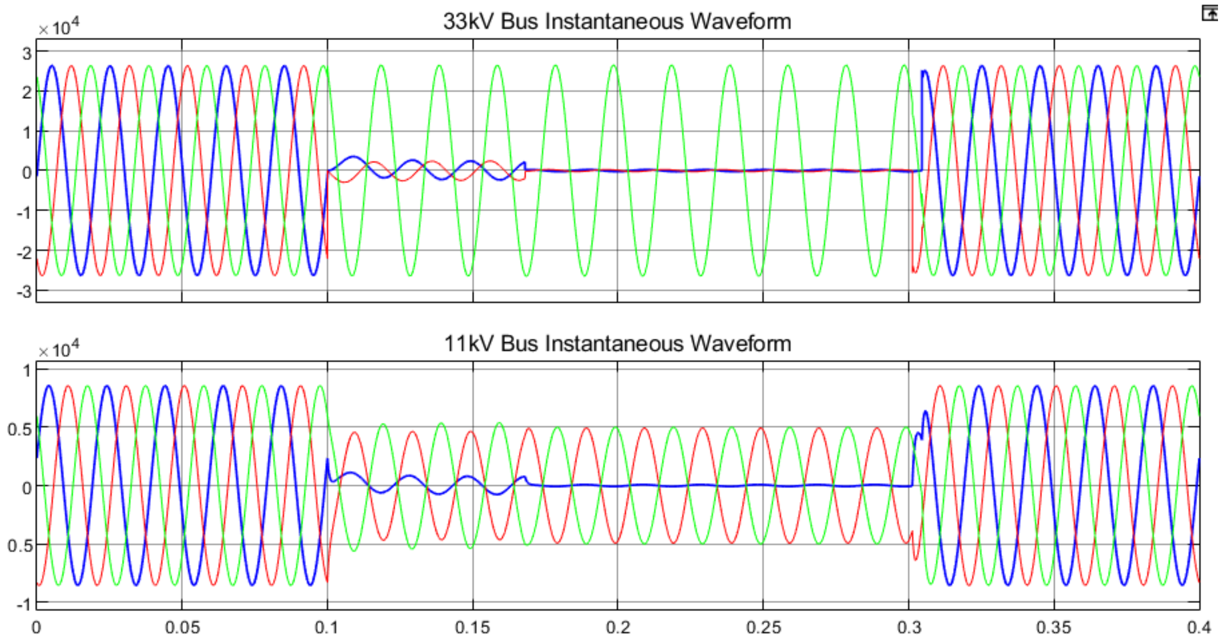

Fig. 2: Voltage sag exhibited due to line-to-line fault at 33 kV line

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It is very common practice to present waveform of voltage sag magnitude in RMS waveform. Figure 3 shows RMS analysis of voltage sag waveforms caused by line-to-line fault in Figure 2. It is very clear that oscillations, which have occurred during pre-fault and post fault sags.

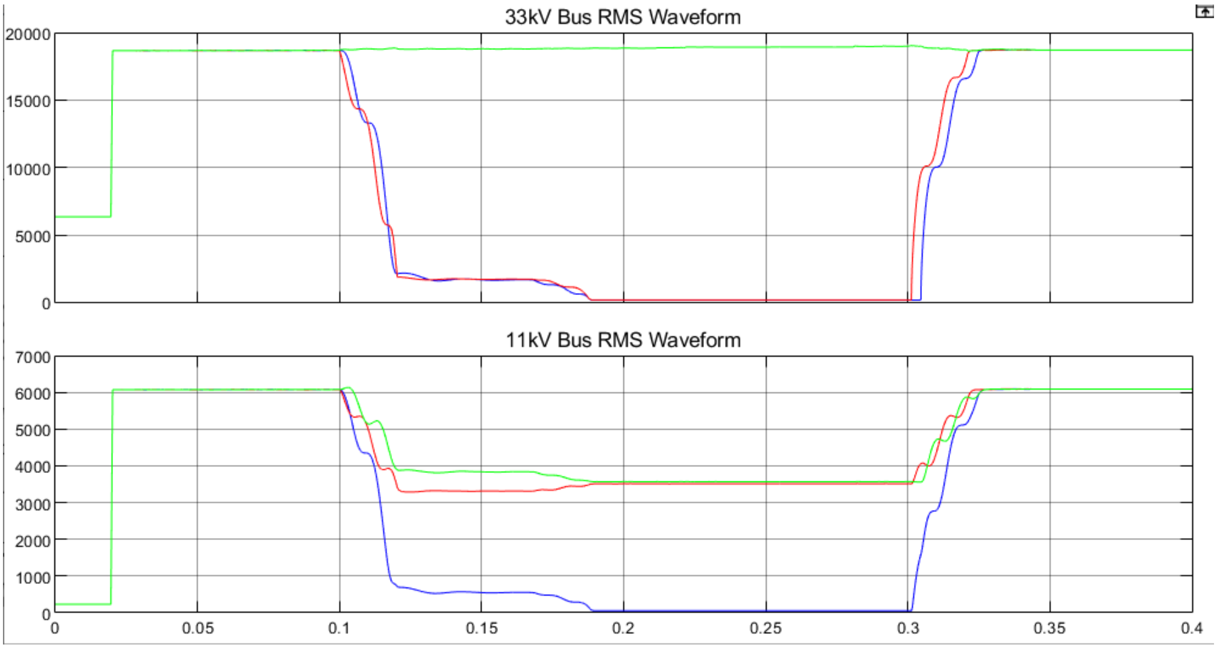

Fig. 3: RMS analysis of voltage sag waveform.

Model of Power quality disturbance due to starting of Induction motor:

Starting of Induction motor also causes voltage sag. The developed model is shown in Figure 4. The model consists of 11 kV, 30 MVA, 50 Hz three-phase source feeder block feeding through 11kV/0.4kV, 1 MVA delta/wye transformers, a three-phase breaker as motor starting contactor, a three-phase induction motor and 10kW resistive load.

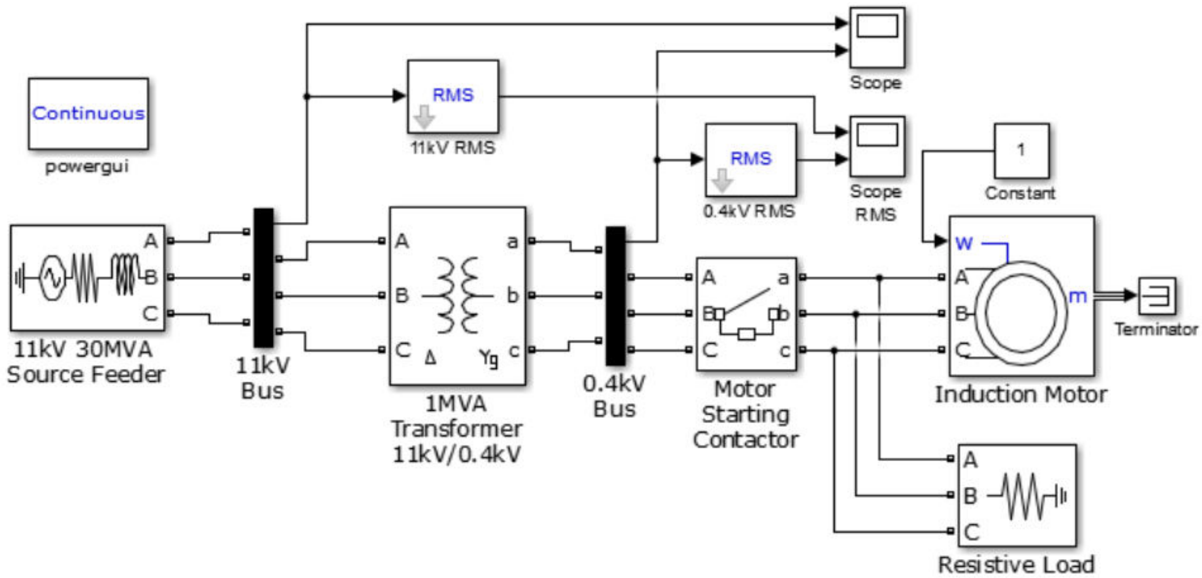

Fig. 4 : Power Quality Disturbance due to starting of Induction motor

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Three-phase voltage sage waveform is shown in Figure 4, which was caused by 100 HP induction motor starting. The angular speed has been set to 1 rad/sec by means of constant block. Three-phase induction motor Magnitude entirely depends on its power rating. RMS analysis has also been shown in figure 5.

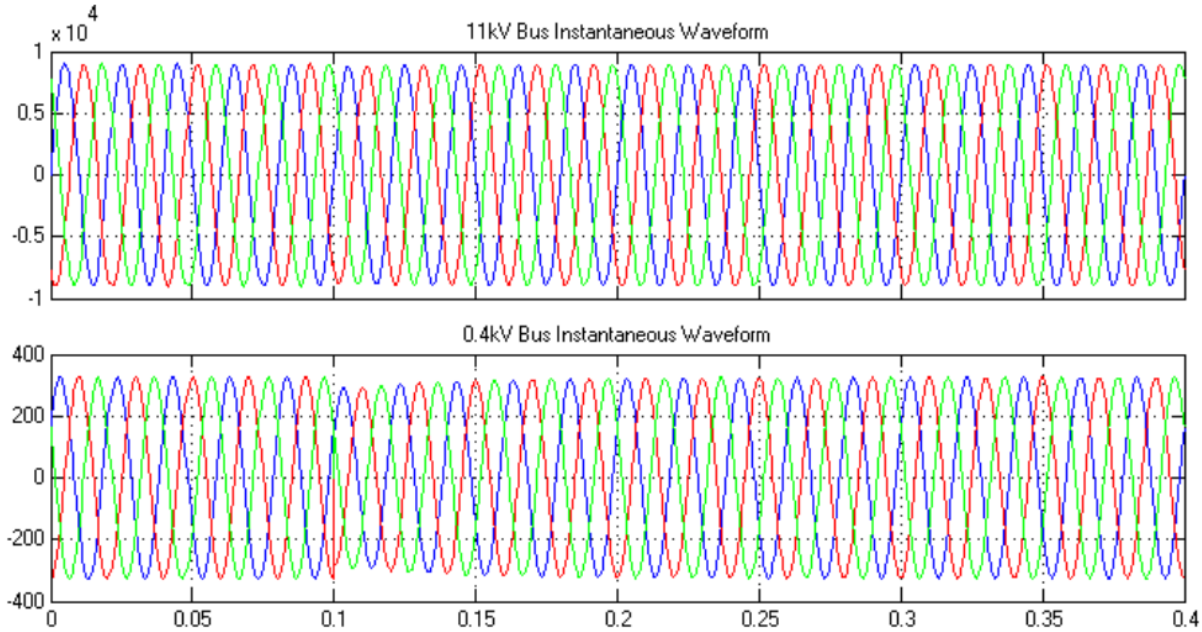

Fig.4: Voltage sag exhibited due to induction motor

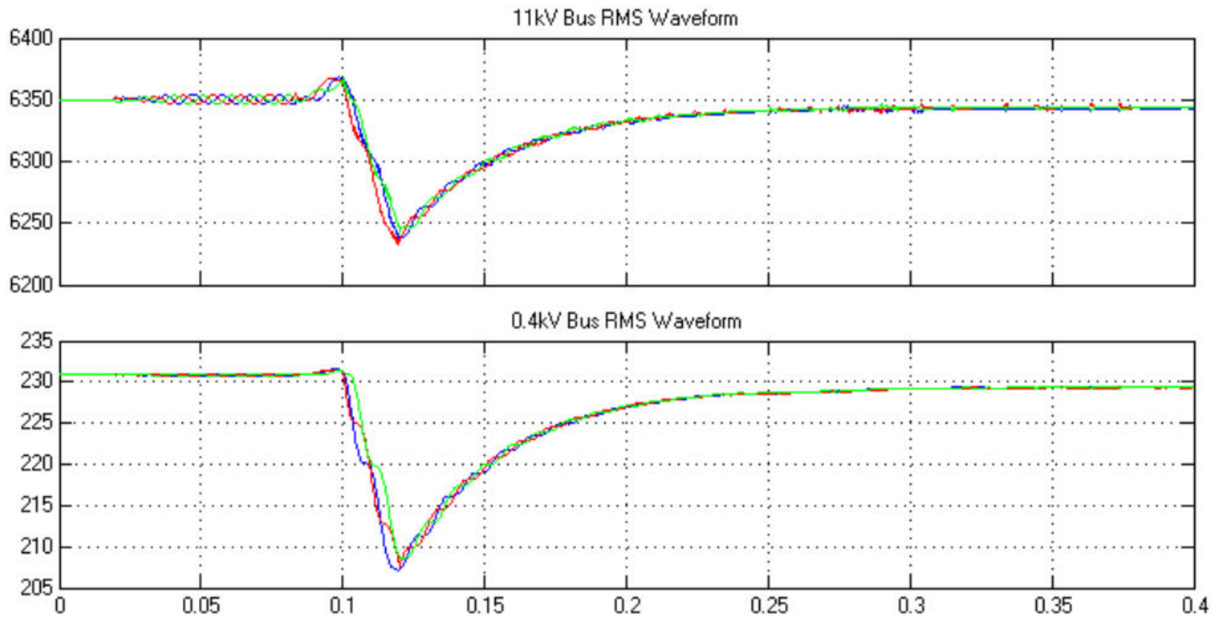

Fig.5: RMS analysis due to starting of induction motor

VI.CONCLUSION

This paper depicts two of the causes of power quality disturbance using line fault and starting of the motor. The Simulation is performed using MATLAB/SIMULINK. The Simulated results clearly show the variation in voltage sag and the RMS value of voltage before and after a fault near both the buses available in the power system.

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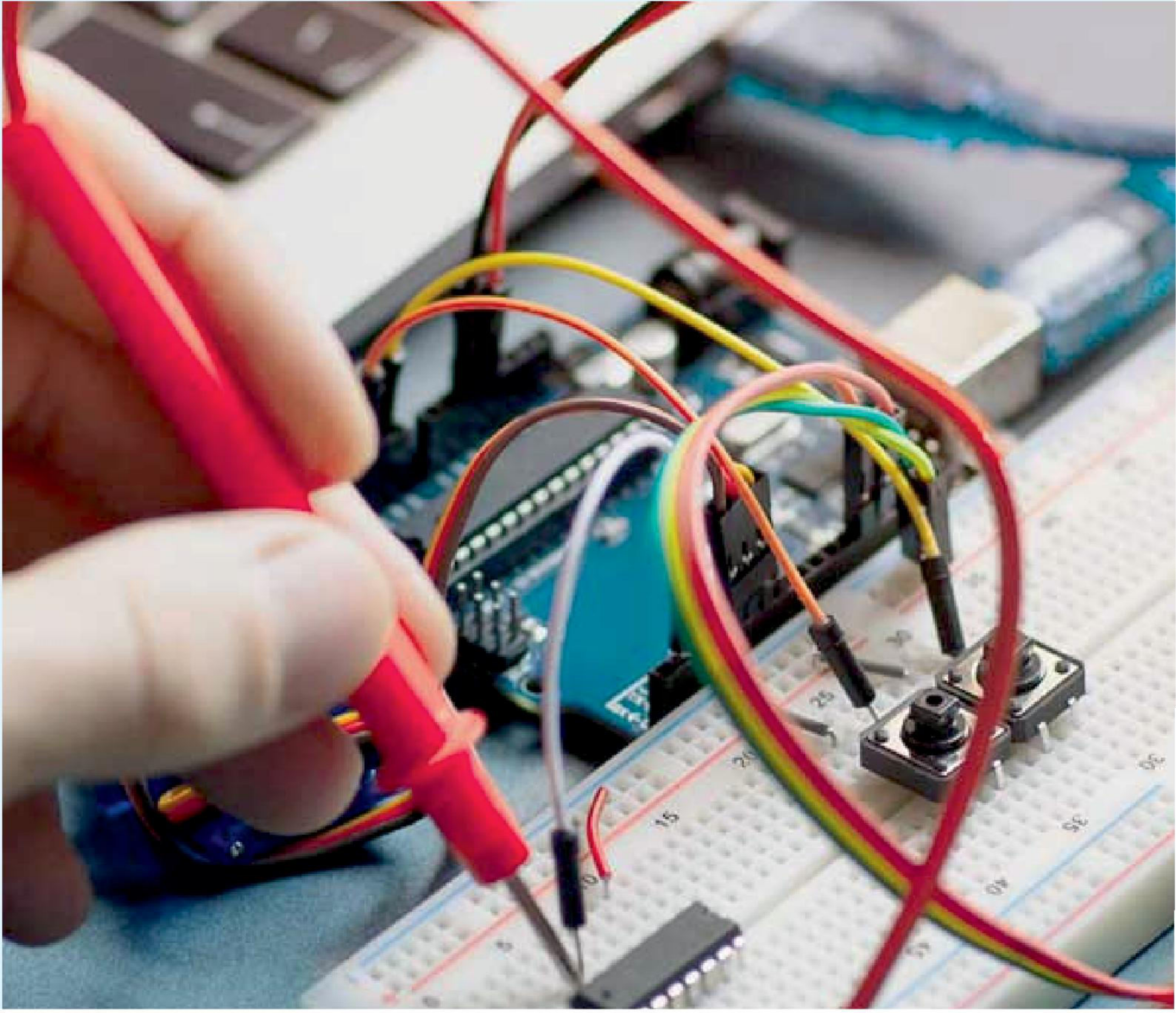

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