IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 11, Issue 5, May 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.18

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE)

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.18|

||Volume 11, Issue 5, May 2022||

|DOI:10.15662/IJAREEIE.2022.1105033 |

Wind Power Plant Profile Improvement Using Static Devices and PID Controller

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ABSTRACT: Due to the limitations of conventional energy sources, wind energy, as one of renewable energy sources, is becoming increasingly important in the field of research. However, stabilizing the voltage obtained from wind vigour has become a main issue. Various methods are used to alleviate this situation. Stability of grid-connected wind farms was improved by reducing voltage fluctuations and using static synchronous compensator (STATCOM) to achieve reactive power compensation.

A current control loop with PID manager is used to controller STATCOM. The PWM method (pulse width modulation) is adopted as a management strategy for STATCOM. During the period of changes in wind speed, different methods (i.e. wind farms with capacitor banks and STATCOM or using STATCOM with proportional-integrated-derivative controllers) have been used to conduct various comparative studies of the stability of the wind farm. This thesis proposes a lattice-connected wind energy conversion system (WECS) based on a dual-feed induction generator (DFIG) with variable speed operation. Consider that the wind itself is intermittent.

KEYWORDS: Wind Energy Conversion System, STATCOM, PID Controller, Renewable Energy Sources

I.INTRODUCTION

The electrical system network is designed to provide continuous power to end users with Safeway. The safe and stable operation of the electricity grid can ensure reduction of social and economic costs, because the instability of the electricity grid can even cause costly poweroutages. The goal requires two phases: the preparation phase, arranging the electrical system network together to achieve predictable utilization, the specific electrical energy load at a particular time, the action phase, to respond to unexpected behaviour and maintain stable power distribution real-time. The service period is the time interval for the operating phase, and its range in different power grids varies from 5 minutes to 60 minutes. The energy produced by unconventional energy is called renewable energy. The energy collected from renewable resources is called renewable energy and is usually supplemented in the human period, such as sun, wind, raindrops, tides, signal waves and heat from geothermal energy. Wind power production has established significantly. In 1999, approx. 10,000 megawatts of wind power production capacity worldwide. In recent years, the world has built more wind power generation units than nuclear power generation capability.

The international vision of wind power production gives the impression that it is quite superior. In 1999, the U.S. Department of Energy set a goal of installing 80,000 megawatts of wind power by 2020. It was declared "American Wind Energy." The electricity generated by this wind power production capacity is approx. 5% of De Vries et al. [2007]. In the second half of 1997, the European Commission's White Paper on "Europe's future energy-renewable energy" was published. Their goal is to reach 40,000 MW of installed wind power capacity by 2010. Finally, in 1999, another 1,500 MW wind turbine was installed and the installed capacity is approx. 4500MW. The worldwide concern about environmental pollution and a possible energy shortage has led to increasing interest in technologies for the generation of renewable electrical energy. Among various renewable energy sources, wind power is the most rapidly growing one in Europe and the United States. With the recent progress in modern power electronics, the concept of a variable-speed wind turbine (VSWT) equipped with a doubly fed induction generator (DFIG) is receiving increasing attention because of its advantages over other wind turbine generator concepts. In the DFIG concept, the induction generator is grid-connected at the stator terminals; the rotor is connected to the utility grid via a partially rated variable frequency ac/dc/ac converter (VFC), which only needs to handle a fraction (25%–30%) of the total DFIG power to achieve full control of the generator. The VFC consists of a rotor-side converter (RSC) and a grid-side converter (GSC)

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connected back-to back by a dc-link capacitor. When connected to the grid and during a grid fault, the RSC of the DFIG may be blocked to protect it from over current in the rotor circuit. The wind turbine typically trips shortly after the converter has blocked and automatically reconnects to the power network after the fault has cleared and the normal operation has been restored. The author proposed an uninterrupted operation feature of a DFIG wind turbine during grid faults.In this feature, the RSC is blocked, and the rotor circuit is short-circuited through a crowbar circuit (an external resistor); the DFIG becomes a conventional induction generator and starts to absorb reactive power.

The wind turbine continues its operation to produce some active power, and the GSC can be set to control the reactive power and voltage at the grid connection. The pitch angle controller might be activated to prevent the wind turbine from fatal over speeding. When the fault has cleared and when the voltage and the frequency in the utility grid have been reestablished, the RSC will restart, and the wind turbine will return to normal operation. However, in the caseof a weak power network and during a grid fault, the GSC cannot provide sufficient reactive power and voltage support due to its small power capacity, and there can be a risk of voltage instability. As a result, utilities, typically, immediately disconnect the wind turbines from the grid to prevent such a contingency and reconnect them when normal operation has been restored.

II.LITERATURE SURVEY

F. Blaabjerg et al.describes about control and grid synchronization for distributed power generation systems in [1]. Further in [2] authors have presented focus on Power electronics converters for wind turbine systems. Y.Gui et al. discussed about Passivity-based control with nonlinear damping for type 2 STATCOM systems in [3]. F. Blaabjerg et al. describes about Distributed power generation systemsand protection in [4]. In [5] authors discussed control of power electronic converters and systems. In [6] X. Guo et al. presented Leakage current suppression of three-phase flying capacitor PV inverter with new carrier modulation and logic function. In [7] Y. Gui et al.describes passivity based coordinated control for islanded AC microgrid. In [8] M. Kazmierkowski et al described current control techniques for three-phase voltage-source PWM converters: a survey. In [9] P. Rodr´ıguez et al. described about multiresonant frequency-locked loop for grid synchronization of power converters under distorted grid conditions. In [10] M. K. Ghartemani et al. discussed about Problems of startup and phase jumps in PLL systems. D. Dong et al.in [11] described about analysis of phase- locked loop low-frequency stability in three-phase grid-connected power converters considering impedance interactions. In [12] M. Davari et al. described Robust vector control of a very weak-grid-connected voltage-source converter considering the phase locked loop dynamics. In [13] B. Kroposki et al. described about Achieving a 100% renewable grid: Operating electric power systems with extremely high levels of variable renewable energy. In [14] S. Larrinaga et al. described about Predictive control strategy for DC/AC converters based on direct power control. In [15] B. Alonzo et al. described about modelling the variability of the wind energy resource on monthly and seasonal timescales. In [16] Z. Chen et al. Maximum wind energy extraction for variable speed wind turbines with slow dynamic behaviour. In [17] A. Touhami et al. described about Control of a wind energy conversion system equipped by a STATCOM for power quality improvement. Therefore, voltage stability is the crucial issue in maintaining uninterrupted INTERNATIONAL JOURNAL OF RENEWABLE ENERGY RESEARCH Bindeshwar
Singh ,Vol.2, No.2, 2012 167 operation of wind turbines equipped with DFIGs. With the rapid increase in penetration of wind power in power systems, tripping of many wind turbines in a large wind farm during grid faults may begin to influence the overall power system stability. It has been reported recently that integration of wind farms into the East Danish power system could cause severe voltage recovery problems following a three phase fault on that network. Development of wind power in India began in December 1952, when Maneklal Sankalchand Thacker, a distinguished power engineer, initiated a project with the Indian Council of Scientific and Industrial Research (CSIR) to explore the possibilities of harnessing wind power in the country. In September 1954, a Symposium on Solar Energy and Wind Power organized by the CSIR and UNESCO was held in New Delhi; among the attendees was E. W. Golding, a British power engineer and authority on wind energy generation.

Allgaier wind turbine, which was presented to India by the West German government; experiments at Porbandar with the latter had commenced by 1961.[15][14] The Indian government also considered a proposal to erect over 20,000 small to medium-sized wind-powered electrical generators in rural districts, to be used for powering water pumps and supplying electricity for remotely situated structures such as lighthouses [15], especially 4000 MW onshore wind power. Due to the expansion of existing capacity, wind power production is one of firmest growing industries. The latest data from Danish wind turbine producers' suggestion show thatpower manufacture has improved six times in the last five years with an average annual progress rate of 44%. Grigsby [2007] Bansal et al. [2005] pointed out that German wind turbine exports have shown an optimistic trend. Compared to 1998, the development rate in 1999 was

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42%. Wind power is a competitive technology with more than 20 years of pollution-free energy production. Wind power gives countries a double-digit percentage of electricity production like nuclear power, Wind energy has become the world's leadingenergy source for the future. If the wind is injected into the grid, it will disturb circulation network or entire grid. The function of supply network is mostly limited to the connection among the transmission and generation structure in one area, while there is no linear load on the other side. As a result, the system is interpreted as a passive system.

III.METHODOLOGY AND DISCUSSION

The addition of mutable speed wind turbines or DFIG has received increasing attention. Compared to SCIG and PMSG, DFIG has many benefits, such as high efficacy, flexible control, fast active or responsive power control or condensed mechanical load. The stator for DFIG is fed straight into the three-phase structure, while its rotor is fed into the UG through the modifier or back-to-back converter, as show in figure. The converter's main part is the RSC, the GSC or the DC bus condenser. The converter is also used. RSC can be used to measure vigorous strength and reactive power. The GSC controls the energy of the DC bus. In addition, it can ensure the process of the converter in units with power feature. The power converter accounts for approximately 20% to 30% of total power to achieve complete supervisor of generator. Therefore, related to a full-speed WES with a full-class converter, the cost converter is reduced and the power loss is minimized.

STATCOM

Due to inadequate reactive power support, power quality or dynamic performance of the delivery power scheme during the interference period are poor. This may be due to additional pressure on the network due to harmonic pollution and load imbalance or unnecessary energy imbalance causing pressure on other loads connected to same network. Plastic AC transmission system (FACTS) equipment such as static synchronous compensator (STATCOM) can be used to solve power quality matters connected to transmission lines, while STATCOM can recover power quality and dynamic performance of delivery system.

A static synchronous compensator (STATCOM) is a sensitive power compensation unit connected in parallel. This unit can generate and / or absorb responsive power at a given bus location, and output may vary therein. Usually, the proportional and integrated (PI) controller is used to regulator process of circulation static compensator (STATCOM) in the distribution system. Though, as power system is very non-linear and susceptible to different interferences,PI-controlled STATCOM cannot provide the best presentation for dissimilar operating points.

PID Controller

Proportional integrated derivative (PID) manager is a control loop instrument that uses replay and has been used in manufacturing controller systems and several submissions that require unceasing inflection control. The PID controller constantly analyses the error values e (t) {displaystyle e (t)} e (t) as changes to expected time zone (SP) and measurable errorrate (PV) , and adjust it accordingly. Or a differentiated expression (representing each P, I and D), that is the name. An example every day is the in-car travel control system. When constant power is used, the speed is reduced.

Proposed Scheme

It consists of following components in a module. The simulink model scheme is shown in Fig.1.

- Double-fed induction generator (DFIG)
- STATCOM
- Machine Side Converter (MSC)
- DC link
- Grid Side Converter (GSC)
- AC Grid

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- PID
- LOAD

The energy controller scheme can be used for either PID controllers or systems without PID controllers. If there is no PID controller, there will be energy vacillations or system will be unstable. However, with the help of PID controller, energy fluctuation is small and the required output can be achieved. This can provide better presentation and stabilize thesystem.

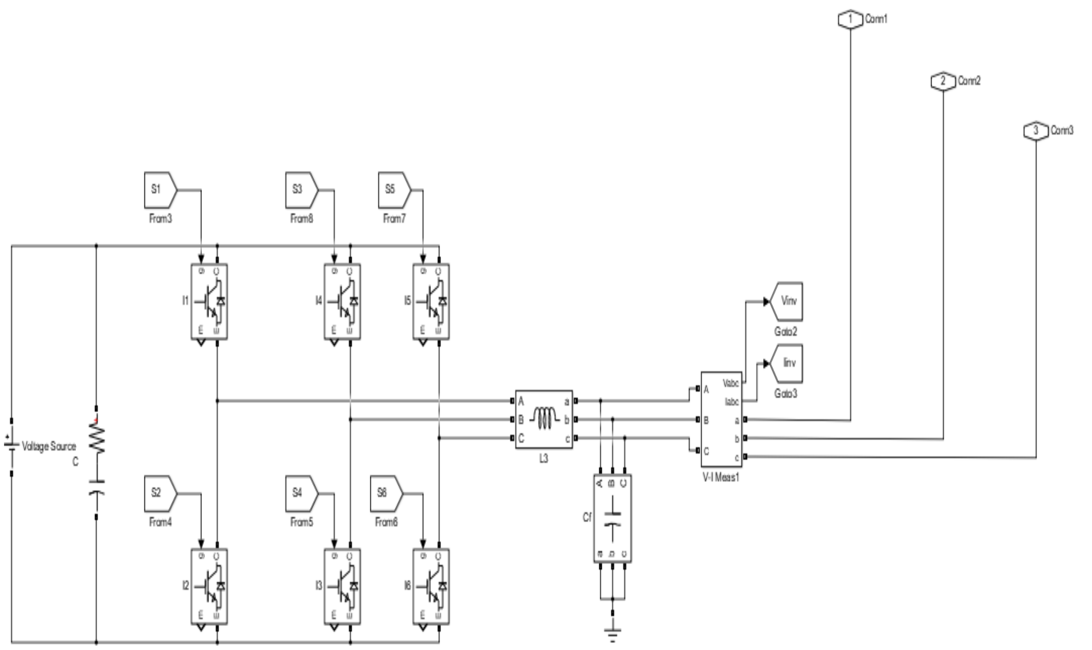

Fig. 1 Proposed scheme

IV. RESULT AND DISCUSSION

By providing sufficient reactive power to the wind farm, the voltage of the wind farm can be stabilized more stable than the capacitor bank. Therefore, the STATCOM system is more efficient. Finally, by using STATCOM and PID controllers to reduce voltage fluctuations andachieve reactive power compensation, the stability of grid-connected wind farms can be improved as shown in Fig.2 and Fig.3.

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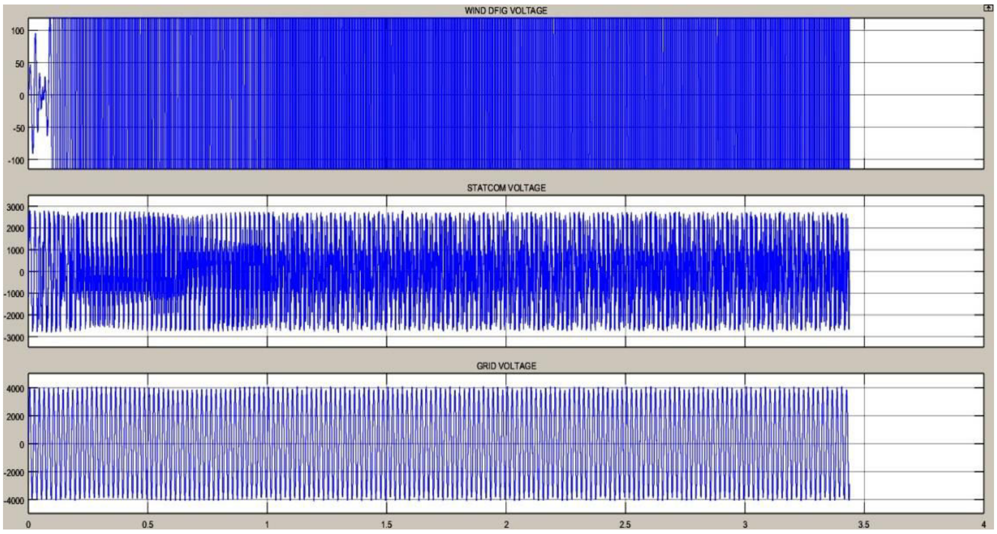

Fig. 2 Wind and grid voltage with proposed scheme

In Fig 3 It is clear that the RMS voltage is very much improved with STATCOM and PID controller application.

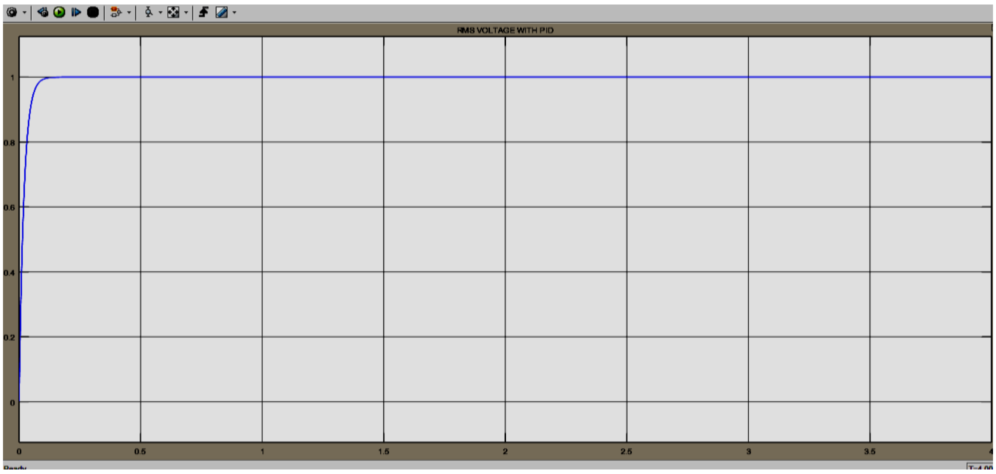

Figure 3 RMS voltage with controller

V.CONCLUSION

This paper studies the properties that can solve the power quality problem in the wind energy adaptation system and adopt an appropriate regulation program to improve the power quality of the mains-connected wind energy conversion system. Use MATLAB / SIMULINK to simulate the control plan for power generation system to recover power worth proposed .Thecontrol scheme has the ability to cancel the harmonic part of load current . It can keep the power supply voltage and current in phase or provision responsive power requirement ofwind turbine and the load of PCC in the grid system, providing an occasion to improve application rate of the transmission line. The results show that STATCOM is more efficient for stabilizing RMS voltage and terminal voltage on the capacitor bank. STATCOM along with PID controller can successfully. This work educations the constancy examination of STATCOM. A voltage control loop with PID controller or pulse width modulation (PWM) has been used to control STATCOM. The outcomes show that STATCOM is more efficient for stabilizing RMS energy or terminal energy on the capacitor bank. STATCOM and PID controller together deliver adequate reactive power to wind farms, which can stabilize the wind farm energy more efficiently than capacitor banks. Finally, by using STATCOM and PID controllers to reduce voltage fluctuations andachieve reactive power compensation, the stability of grid-connected wind farms can be improved.

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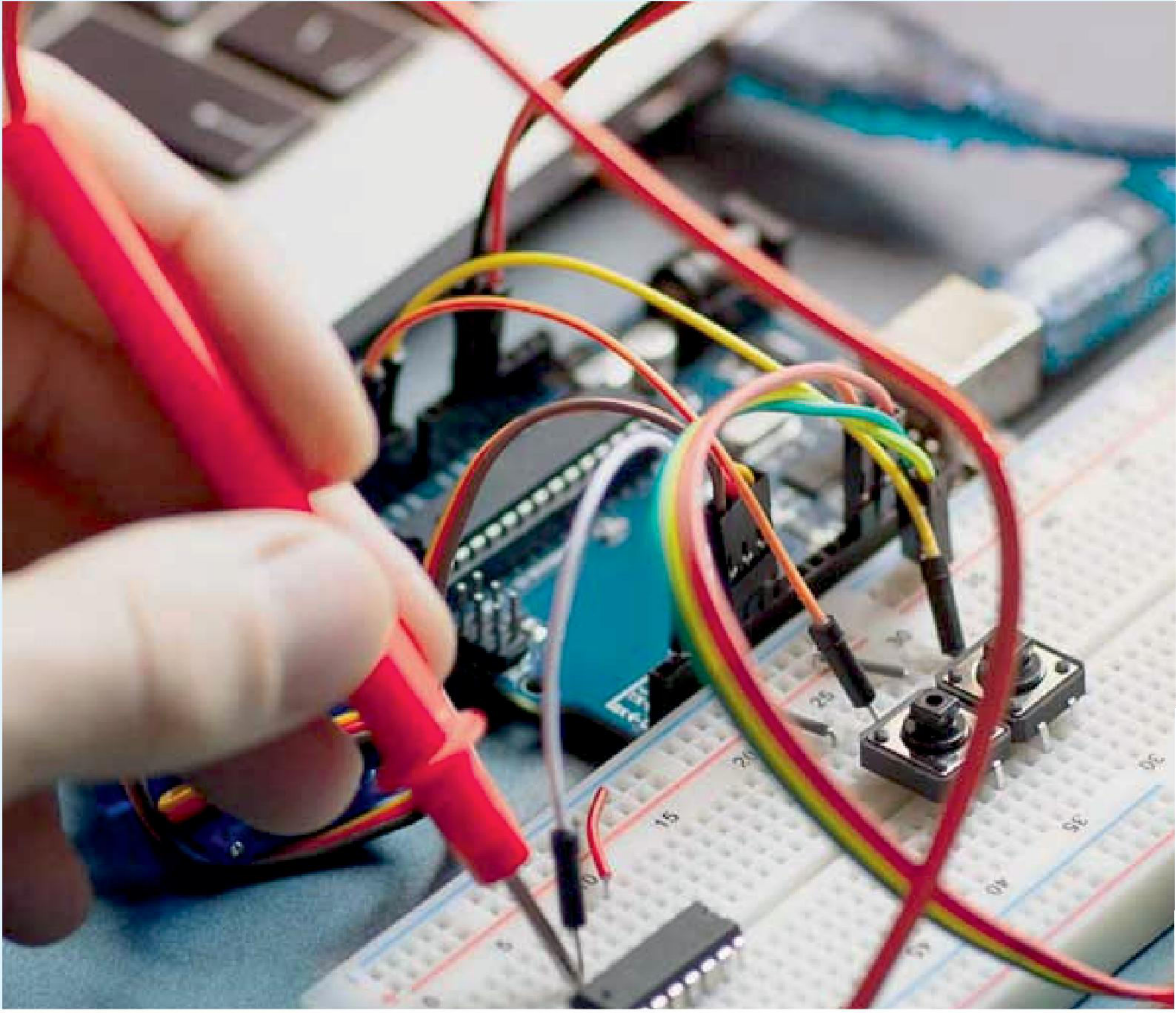

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