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Maximum Power Extraction of Wind by the Real Time Climate Analysis of Selected Location

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ABSTRACT: In this work an idea of extracting maximum power from the wind at any particular selected location has been identified. The Fuzzy control system has been designed for the maximum power point tracking system and the rule table also defined as per the characteristics of wind power density and wind speed retrieved from the website. After the analysis of average wind speed and overall wind rose diagram of that selected location will give firstly the direction of placing the wind turbine by looking at the past data of wind direction flow will be highest from the average and the wind speed will be higher at that altitude. Various software are available at which after putting the latitude and longitude of the location several information's like temperature, pressure, precipitation and wind velocity like details can be observed and that will be helpful in designing of control system technique. Modelling has been done in the Matlab by using wind energy conversion system basic components and parameters. In this system all the basic components like inverter and control system along with the grid has been designed to have a look on the output to have a basic model working with fuzzy control system. The rule set can also be changed as per the location selected and the past data available on the website.

KEYWORDS: Maximum Power Point tracking MPPT, Total Harmonic Distortion THD, Wind rose diagram, Flexible AC transmission system FACTS, MNRE Ministry of new and renewable energy.

I. INTRODUCTION

The world constraint of fossil fuels reserves and additionally the ever growing environmental pollutants have driven powerfully throughout ultimate many years the occasion of renewable strength sources (RES). The necessity of getting obtainable property power systems for substitution bit through bit trendy ones demands the improvement of systems of power provide based on smooth and renewable resources. At present, solar electric photovoltaic (PV) era is ahead redoubled significance as a RES application because of distinctive blessings like simplicity of allocation, high responsibility, absence of gasoline value, low preservation and absence of noise and wear thanks to the absence of moving factors or practical's. Moreover, the alternative energy characterizes a clean, pollutants-loose and inexhaustible power supply. Additionally to those elements are the declining value and expenses of solar PV modules, associate degree increasing efficiency of sun cells, producing generation enhancements and economies of scale [1].

For the installation of wind energy MNRE scheme (The Ministry of New & Renewable energy) has introduced to aware more and more people about this technology, government also gives incentives in order to promote wind energy. Wind is air in motion; this is actually derived from solar energy. About 2% of total solar flux that reaches the earth's surface is transformed into wind energy due to uneven heating of atmosphere. This kinetic energy of wind is used to gain the rotational motion of wind turbine which is coupled with an electrical generator to supply over a region acting as stand-alone or supplying power to a grid. An actual WECS (Wind energy conversion system) be considered as follow [2]

As per the energy scenario we can see that power demand increasing every year and within next few years it will increase in a large manner and in several lakhs of Megawatts and to fulfil all this requirement power generation will also increase and due to the use of excess fossil fuels increase in the level of carbon monoxide and other toxic gases will also increase and affect the environment badly. So A clean energy and green energy schemes should be increased by increasing the power generation capacity by renewable sources like solar and wind energy.

As per the commitments under the UN Paris climate agreement in 2015 announced its renewable energy targets for 175 GW from renewable energy generations by 2022 and this target includes 60 GW from wind energy. India has a good record in the on shore wind capacity of 33 GW installation completed till September 2017 and this makes India fourth largest market in installation of wind energy.

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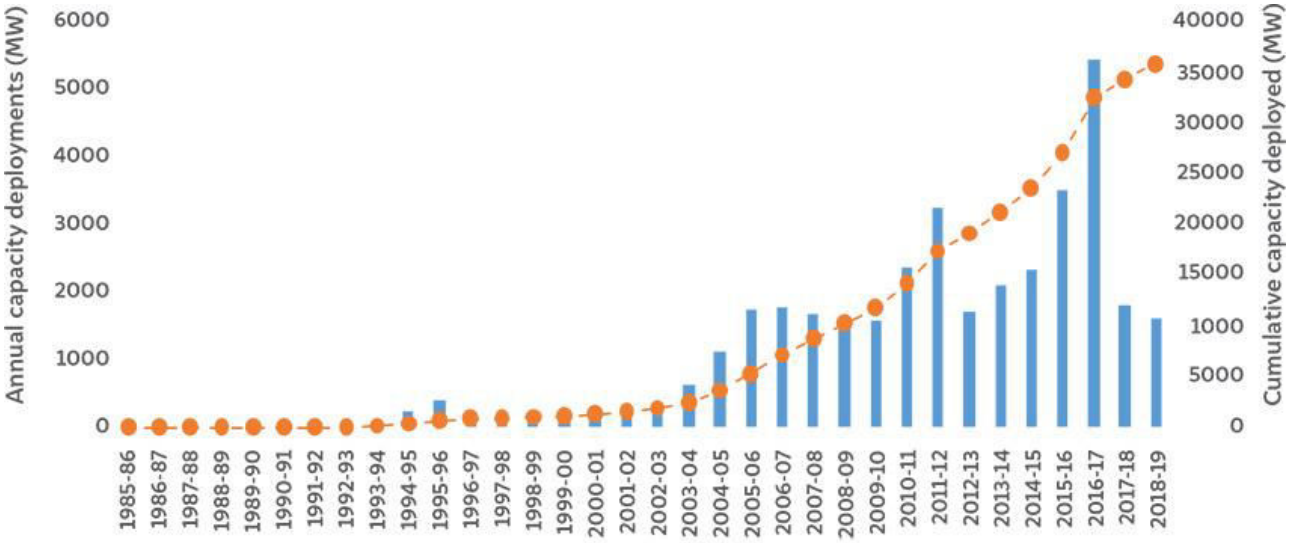

Fig -1: Annual Wind Capacity Addition in India source (MNRE)

II. CLIMATE ANALYSIS

Wind turbine has to be installed in any location decided. First step is to work on the prefeasibility study in detail about that site selected. For this we can use various software available like in this work the climate consultant software has been used. This software will give the basic climate details of all over the year like wind speed, density and about the directions of wind in miles per hour as well as direction. The major aim is to place the wind turbine according to climatic situation of the selected site to extract maximum power from the wind.

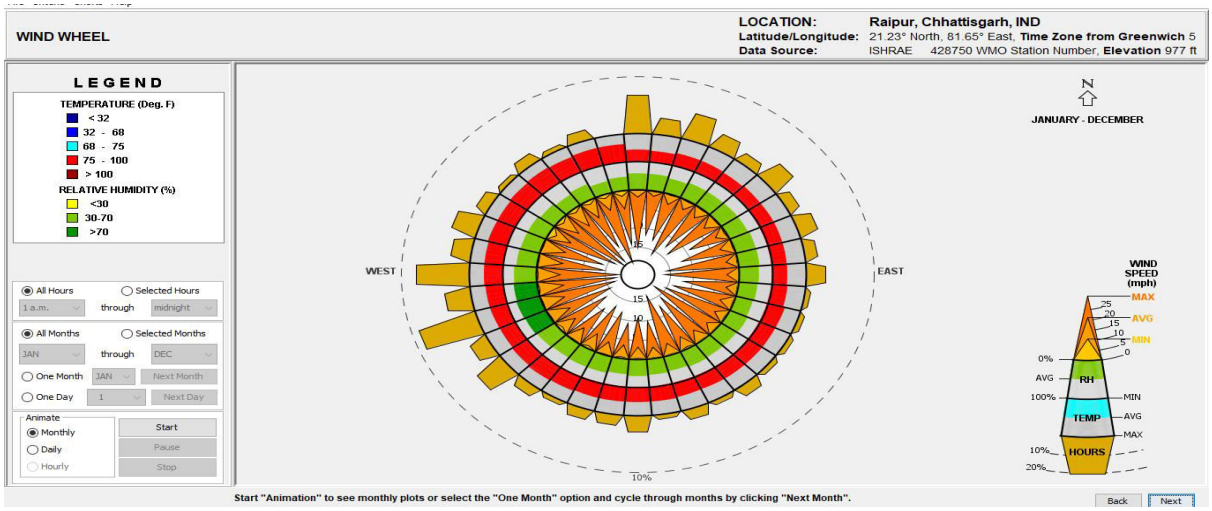

Fig. 2 Wind Wheel Plot

The selected location is the capital of the state in India called as a Raipur city. For the analysis a software used and feed the data of the location we can easily find out the wind speed direction and other weather details like solar radiation intensity, humidity, precipitation and degrees of the wind. While designing the control system all these data retrieved taken into consideration for the maximum utilisation of wind in the generation plant. In below details we can easily find out the monthly basis wind speed and in miles per hour as per the data the wind speed May to September month and generation will be in higher state during this period.

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Climate Consultant 6.0 (Build 12, Sep 22, 2017)

File Criteria Charts Help

WEATHER DATA SUMMARY

LOCATION: Raipur, Chhattisgarh, IND
Latitude/Longitude: 21.23° North, 81.65° East, **Time Zone from Greenwich** 5
Data Source: ISHRAE 428750 WMO Station Number, **Elevation** 977 ft

MONTHLY MEANS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Global Horiz Radiation (Avg Hourly)	126	135	163	171	178	141	115	107	114	128	104	104	Btu/sq.ft
Direct Normal Radiation (Avg Hourly)	157	138	168	163	172	100	42	37	57	105	89	110	Btu/sq.ft
Diffuse Radiation (Avg Hourly)	36	47	44	51	47	66	82	78	73	59	50	43	Btu/sq.ft
Global Horiz Radiation (Max Hourly)	271	282	351	363	431	355	278	265	272	290	252	234	Btu/sq.ft
Direct Normal Radiation (Max Hourly)	399	379	381	430	445	392	195	209	247	325	304	371	Btu/sq.ft
Diffuse Radiation (Max Hourly)	103	129	139	158	161	161	161	161	154	140	114	104	Btu/sq.ft
Global Horiz Radiation (Avg Daily Total)	1376	1523	1950	2147	2326	1875	1516	1360	1390	1476	1144	1123	Btu/sq.ft
Direct Normal Radiation (Avg Daily Total)	1714	1553	2012	2037	2247	1329	563	474	694	1206	977	1184	Btu/sq.ft
Diffuse Radiation (Avg Daily Total)	397	533	528	640	623	884	1088	1003	890	679	549	461	Btu/sq.ft
Global Horiz Illumination (Avg Hourly)													footcandles
Direct Normal Illumination (Avg Hourly)													footcandles
Dry Bulb Temperature (Avg Monthly)	67	74	82	89	93	87	81	80	81	78	73	68	degrees F
Dew Point Temperature (Avg Monthly)	47	56	57	60	60	69	75	75	75	64	63	56	degrees F
Relative Humidity (Avg Monthly)	51	55	46	40	37	63	83	85	80	65	73	68	percent
Wind Direction (Monthly Mode)	20	20	0	230	270	250	250	250	250	0	50	0	degrees
Wind Speed (Avg Monthly)	0	1	3	2	3	5	4	3	4	1	1	1	mph
Ground Temperature (Avg Monthly of 3 Depths)	72	71	71	73	78	82	86	88	87	84	80	76	degrees F

Fig. 3 Weather data summary of location

III. FUZZY CONTROL DESIGN

In previous works many research is going on of fuzzy based design for maximum power extraction. The prefeasibility study is also very helpful in designing these type of intelligent control system like fuzzy and artificial neural network. The weather data can be fed as per the control system and the rule table design accordingly to get better output of the wind energy conversion system and less amount of losses with better power quality.

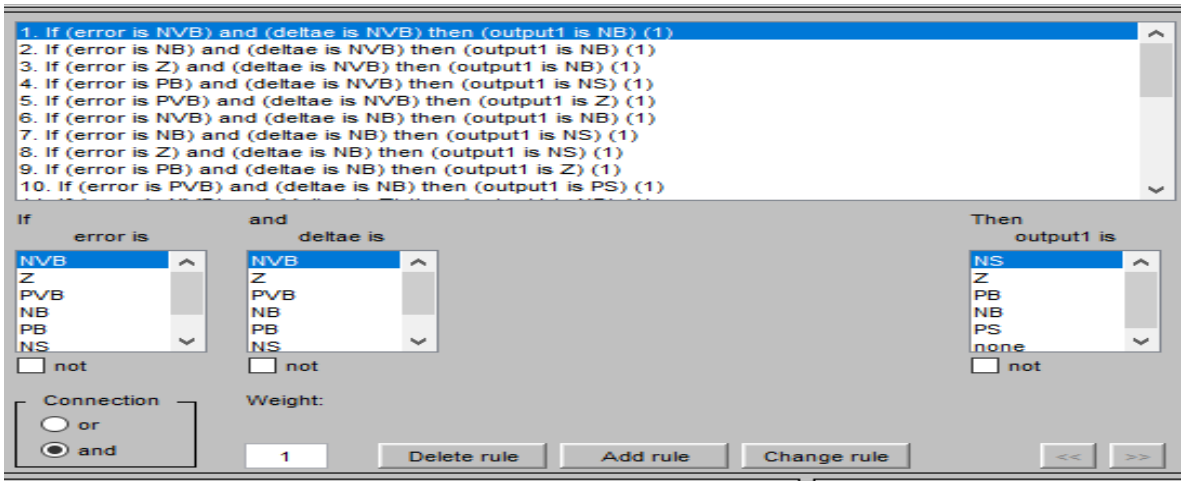

Fig. 4 Rule table design

IV. RESULT AND DISCUSSION

A simple Matlab modelling of a wind energy conversion system is connected with the grid and loads with the necessary control system is designed with a fuzzy logic system and the rule table design as discussed above. The wind direction speed and wind power density will be considered. We can get a much better output the waveform of the voltage current and power of three phase has a sinusoidal waveform with better amplitude. The performance improvement is also required in the system for much better power quality by the use of Facts devices inclusion in the system.

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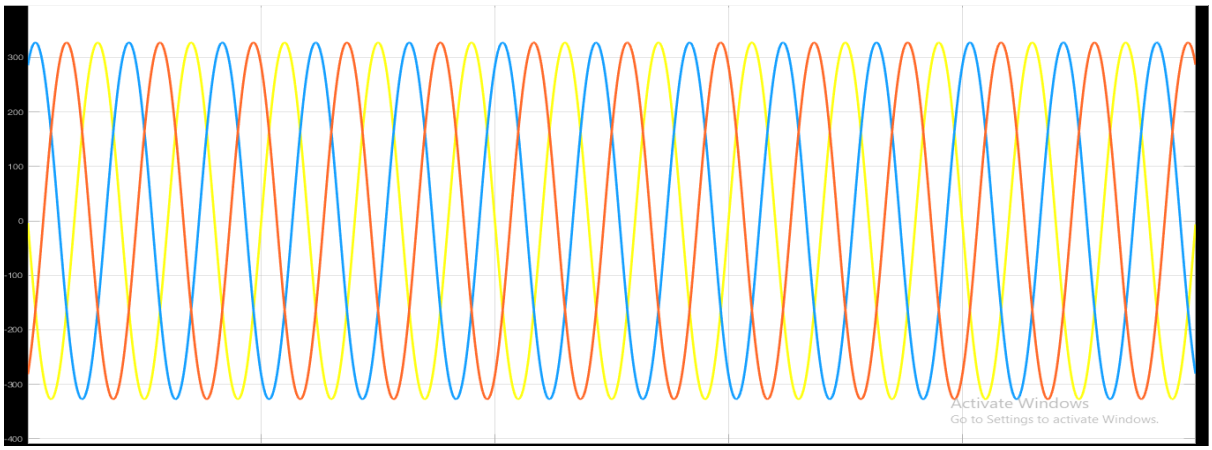

Fig. 5 Three Phase Voltage

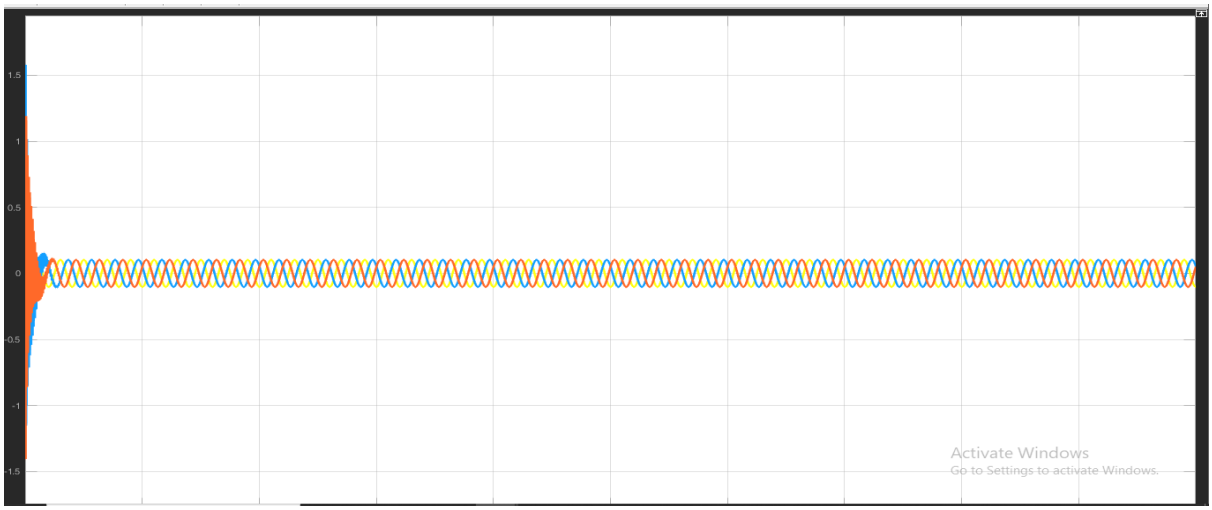

Fig. 6 Three Phase Current

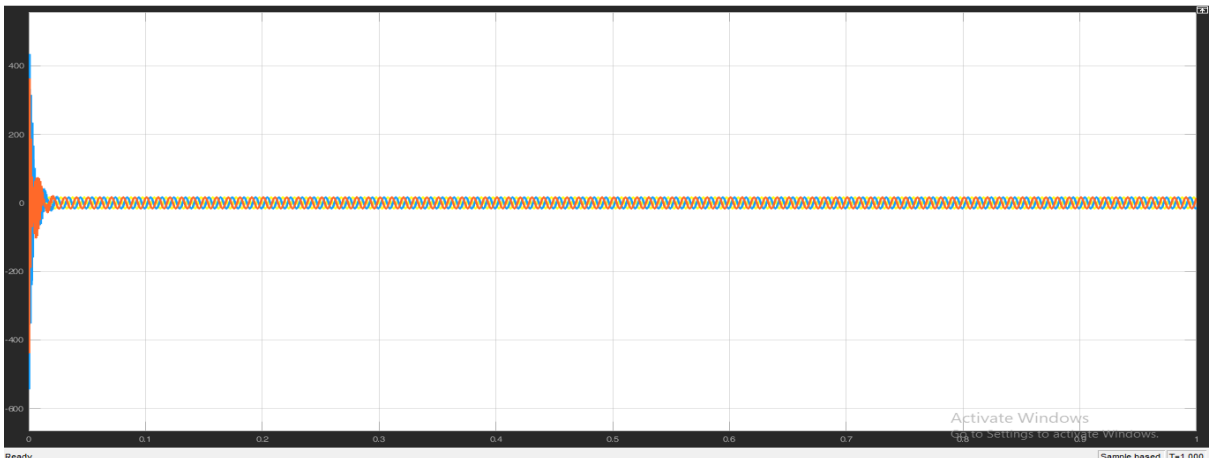

Fig. 7 Three Phase Power

V. CONCLUSION

In this work the climate analysis has been done of a particular selected location and after obtaining the wind characteristics it becomes very easy to review the generation from the installed wind turbine and in which direction we can install the

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turbine all these details can be taken and analyse accordingly and a fuzzy control system for the maximum power point extraction can be design accordingly by making the rule table and set the predefined rules. A simple Matlab model of a wind energy conversion system can be designed and connect with the fuzzy based control system to find out the outputs and sinusoidal waveform of voltage current and power obtained with a little distortion which needs to be improved in future works.

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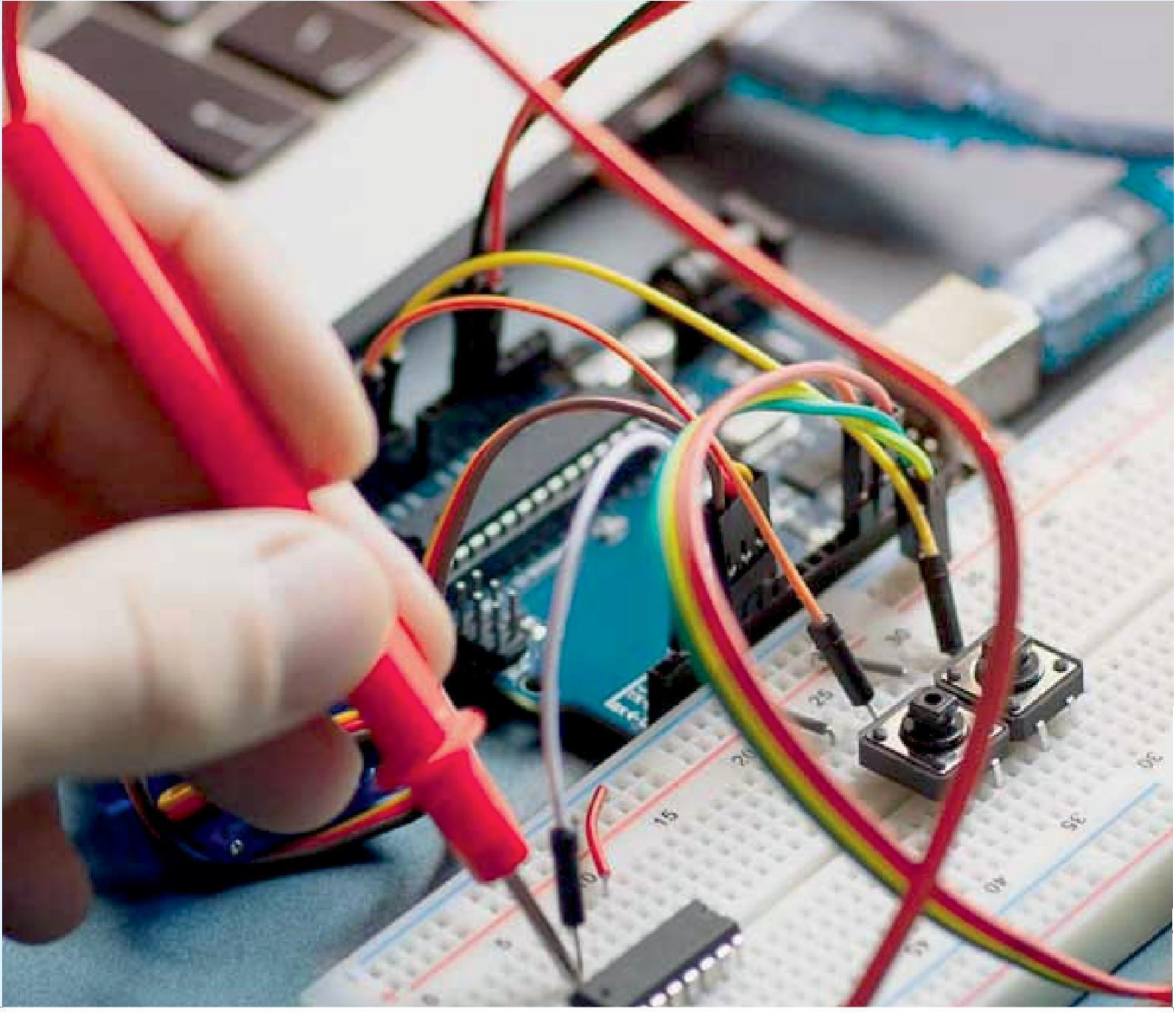

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