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2D Solar Tracking System by Using Ardunio

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ABSTRACT: Solar energy is rapidly gaining notoriety as an important means of expanding renewable energy resources. It has emerged as one of the most promising renewable energy source characterized by a huge potential of conversion into electrical power. The problem is that, the conventional solar panel power system is stationary, means the solar panel will not always be facing to the direction of sun, this make the light intensity falling on the solar panel is not maximum level so the solar panel will not always work in its maximum performance. This paper will include the design and construction of Dual axis solar tracking system by using LDR. This solar move in any direction (horizontal as well as vertical). The proposed system uses controller as a brain to control the whole system. The (light dependent resistor (LDR) had been used to sense the intensity of light and sent the data to the controller. This controller will compare the data and rotate the motor to right direction. The sun tracking is performed by changing the solar panel orientation in horizontal and vertical direction by two motors. A working system will ultimately be demonstrated to validate the design.

KEYWORDS: ARDUINO, FINGER PRINT SENSOR MODULE,MAX 232,LDR

I.INTRODUCTION

Today solar energy is seen as the most reliable renewable energy source. According to calculations the sun deposits 120,000 TW of radiation on the surface of Earth. The sun covers about 0.16% of the land on Earth. With 10% efficient solar conversion systems we can generate almost 20 TW of power, which is almost twice the world's consumption. The above comparisons show that solar energy have impressive magnitude, it provides more energy than present day human technology can provide. The first solar cells were developed about 50 years ago by Bell Laboratories in 1954.The solar cells were used as power source in satellites. In the end of 1970 scientists were able to develop silicon solar cells (Photo voltaic cells) on industrial basis, since then these have become more and more attractive. The main steps involved in utilizing solar energy are Capture, Conversion and Storage[1]. The energy of sun reaches on earth in the form of radiations distributed across the color spectrum (Infrared to Ultraviolet).This energy is in the form of excited electron hole so it must be captured as electron hole.

Photovoltaic systems are becoming increasingly popular source of clean energy. Maximizing its power output is desirable to increase its efficiency. In order to maximize power output from solar panels, one needs to keep the panels aligned with thesun. It has been estimated that energyextracted from solar panels can be increased by 20 to 30 percent by utilizing a tracking system instead of a stationary array. Over time different methods have been developed. The most popular ones are astronomical or time based systems, then there are optical methods which use different types of photo-sensors to align the PV modules. The present day scenario of solar energy is rising and has a hugepotential. The cost of solar energy has been reduced from 17.25 Rs/KWh to 7.5Rs/KWh. Huge solar farms are being constructed all over India, with a capacity of 5MWto15MW. A majority of these solar farms currently use stand still PV systems facing a single direction throughout the day, and as a result has lesser efficiency than a dual axis solar tracker[2]. A slow transition is being made from the standstill systems to the dual and single axis solar trackers but a majorhindrance has been the unrealistic cost of the product often ranging in the bracket of 30,000 to 50,000. The next big revolution in the market will be a less expensive dual axis solar tracker with no compromises on quality and efficiency.

II.RELATED WORKS

Cheng,[3] et al., proposed empirical approach forest imating monthly solar radiation on south-facing tilted planes with inclinations from 0° to 90° for building solar energy application. By measurement and the modification of previous estimated irradiation data, which have not yet been verified, the regression equations of monthly slope irradiation ratio with no ground reflection were established. Khadidjaa [4] et al., proposed the performance of solar panels energy

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conversion is dependent on sunlight it receives. Therefore, it is necessary to design a tracker device that can set the direction of the solar panel always follow the sun position. The two-axis sensor less trackers have developed in this research to maximize energy conversion. Position of solar panel move based on sun position using sunrise and sunset database.By using linear inter polation the sun position in latitude and longitude direction for other time can be obtained during a day. Based on these value the solar panel set its position using two servo motor which derived by Arduino. Chong ,[5] et al proposed development of solar energy applications, especially for the high solar concentration systems that directly convert the solar energy into thermal or electrical energy. High degree of sun-tracking accuracy is required to ensure that the solar collector is capable of harnessing the maximum solar energy through out the day. High concentration solar power systems, such as central receiver system, parabolic trough, parabolic dish etc, are the common in the applications of collecting solar energy. In order to maintain high output power and stability of the solar power system, a high-precision sun-tracking system is necessary to follow the suns trajectory from dawn until dusk.Ghias ,[6] et al., proposed design of a fixed photo-voltaic (PV) system that consists of the modules array, DC-AC inverter and switches. The short circuit current and open-circuit voltage of the 66 modules of the system have been investigated in natural conditions. The PV system, with the crystalline and multi crystalline modules of area 0.384m²,and0.391m² respectively, is able to provide an average electric power of ~1.6 kW. The inclination angle between the module and the horizontal planewas equal to 45 deg.

III. DESIGN AND CONTROL METHODOLOGY

In this article, we are going to make a Sun Tracking Solar Panel using Arduino, in which we will use two LDRs (Light-dependent resistor) to sense the light and a servo motor to automatically rotate the solar panel in the direction of the sunlight. The advantage of this project is that the Solar panels will always follow the sunlight will always face the sun to get charge all the time and can provide the supply the maximum power. For automatic mode, the microcontroller converts the analogs values of LDR sensors (pins A0 to A3) intodigitals[7]. Then it controls two servomotors(up-down and left-right) using two Pulse-Width Modulation (PWM) signals (pins 5and 6) to track the sun.The rotation movements occur in two axes, in azimuth from east to west according to the daily sun's path and in elevation from south to north according to the seasonal sun's path For manual mode, a potentiometer (pin A4) is used to control the movement of the two servo motors, a push- button (pin 11) is deployed to connect the potentiometer either to up-down servomotor or left-right servomotor. Besides, another pushbutton (pin 12) is used to switch between the two modes[8]. Furthermore, the PV voltage is measured through the analog pin A5 of the Arduino, then the PV currentis calculated.Since the resistor of the load is already known. Next, the PV current, voltage and power versus time and The actual mode are sent to the computer to present them in real-time on MS Excel.This range is used to stabilize the controller and once the solar tracker is perpendicular to the sun, no further control is made. On the other hand, if the right set of LDRs receive more light, the solar tracker moves in that direction[9].

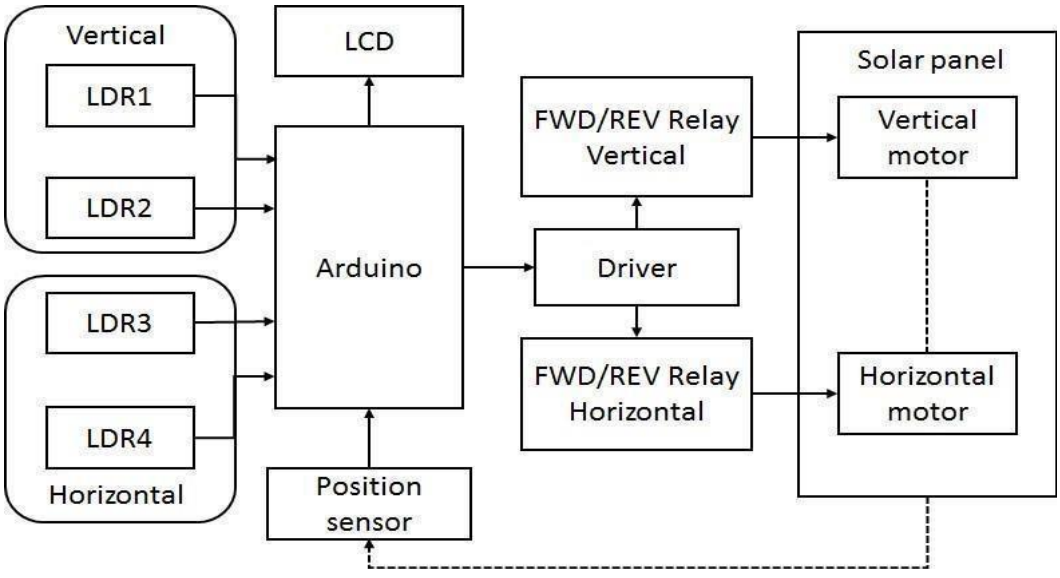

Fig 1.Solar photo voltaic system

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Fig.1 shows the block diagram of solar photo voltaic system.This project is to control the position of a solar panel in accordance with the motion of sun. This project is designed with solar panels, LDR, position sensor, Micro controller, motor and its driving circuit. Renewable energy is rapidly gaining importance as an energy resource as fossil fuel prices fluctuate. As the sun moves across the sky during the day, it is advantageous to have the solar panels track the location of the sun, such that the panels are always perpendicular to the solar energy radiated by the sun. This will tend to maximize the amount of power absorbed by PV systems. The LDR sensor actions the sunlight intensity as a reference input signal. Four LDR sensors used. It is used to detect the radiation in horizontal and vertical direction. This solar move in any direction (horizontal as well as vertical). The LDR (light dependent resist or had been used to sense the intensity of light and sent the data to the controller. This controller will compare the data and rotate the motor to right direction. Position sensor is used to detect the position of solar panel. The sun tracking is performed by changing the solar panel orientation in horizontal and vertical direction by two motors. The motor direction is controlled by driver unit. Driver we used ULN2003. It is used to drive the motor in forward and reverse direction through relay.

Fig.2 shows the circuit diagram of Solar tracking system. Transformer used to convert 230V into 12VAC. 12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. AC capacitor used to charge AC components and discharge on ground. LM7805 regulator is used to maintain voltage as constant. Then signal will be given to next capacitor, which is used to filter unwanted AC component. Load will be LED and resister. LED voltageis1.75V.if voltage is above level beyond the limit, and then it will be dropped on resister. In this project we use Arduino atmega328 controller. Solar panel position is detection by using position switch. It is connected to controller port A0 to A3. In this system we use four LDR sensor. LDR (light dependent resistor) used to sense the intensity of light from sun. These LDRs are connected to controller port A4 to A7. Controller receive the sensor data and to control the motor through driver unit, Driver we use ULN2003 is connected to controller. Driver used to drive the motor through relay. Relay is act as a switch. Four relays are used. Two relays are used to control the motor in forward and reverse direction in vertical. Another two relays are used to control the motor in forward and reverse direction in horizontal. Motor is connected to relay.LCD is also interfaced to controller. It is used to display the short messages.

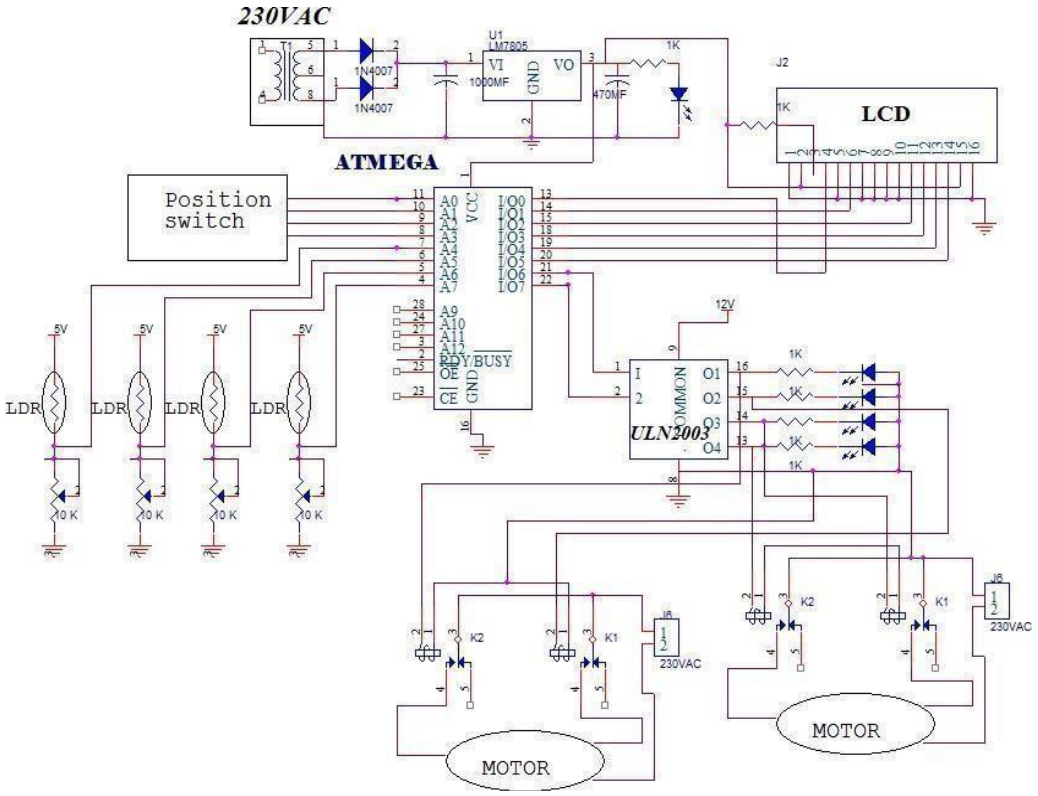

Fig 2. Solar tracking system

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IV. HARDWARE DESCRIPTION

Solar panel (also solar module, photovoltaic module or photo voltaic panel) is a packaged, connected assembly of solar cells, also known as photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Because a single solar panel can produce only a limitedamount of power, many installations contain several panels. A photovoltaic system typically includes an array of solar panels, an inverter, and sometimes a battery and interconnection wiring.

ATmega328 is an 8-bit and 28 Pins AVR Micro controller, manufactured by Microchip, follows RISC Architecure and has a flash type program memory of 32KB.It has an EEPROM memory of 1KB and its SRAM memory is of 2KB.It has 8Pin for ADC operations, which all combines to form Port A (PA0 – PA7).It also has 3 built in Timers, two of the mare 8 Bit timers while the third one is 16-Bit Timer. You must have Heard of Arduino UNO, UNO is based on atmega 328 Microcontroller. Its UNO'sheart. It operates ranging from3.3Vto5.5V but normally we use 5Va s astandard. Its excellent features include the cost efficiency, low power dissipation, programming lock for security purposes, and real timer counter with separateoscillator. It's normally used in Embedded Systems applications.Flash Memory has 32KB capacity. It has an address of 15 bits. It is Programmable Read Only Memory (ROM).It is non volatile memory.SRAM stands for Static Random Access Memory. It is a volatile memory i.e. datawill be remove dafter removing the power supply. EEPROM stands for Electrically Erasable Programmable Read Only Memory It has along term data.ATmega-328 has thirty two (32)General Purpose(GP)registers. These all of the registers are the part of Static Random Access Memory (SRAM).The ULN2001A, ULN2002A,ULN2003 and ULN 2004A are high voltage, high current Darling to n arrays each containing even open collector darling to n pairs with common emitters. Each channel rated at 500mA and can with stand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout. The four versions interface to all common logic families.These versatile devices areuseful for driving a wide range of loads including solenoids, relays DC motors; LED displays filament lamps, thermal print-head sand high power buffers ULN2001A/2002A/2003A and 2004A is supplied in 16 pin plastic DIP packages with a copper lead frame to reduce thermal resistance. They are available also in small outline package(SO-16) as ULN2001D/2002D/2003D/2004D.The ULN2003 A is a high voltage, high current, Darlington Arrays emitters. Each channel rated at 500mA and can with stand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite to outputs to simplify layout. It is a 5V TTL, CMOS. This versatile device is useful for driving a wide range of loads including solenoids, relays, DC motors, LED displays, and high powerbuffers. Outputs can be paralleled for higher current.The ULN 2003IC consists of eight NPN Darling ton pair which provides the proper current amplification required by the loads. We all know that the transistors are used to amplify the current but here Darling to ntransistor pairs are used inside the IC to make the required amplification. A Darlington pair is two transistorsthat act as a single transistor providing high current gain. In this pair the current amplified by the first transistor is further amplified by transistor providing high current to the output terminal.

V.RESULTS

The proposed two –motor design was simple and self –contained, and did not require programming and a computer interface.

The proposed methodology is an innovation so far. It achieves the following attractive features.
1.A simple and cost–effective control implementation.
2.A stand-alone PV inverter to power the entire system.
3.Ability to adjust the tracking accuracy.
4.Applicable to moving platforms with the Sun tracker.

Panel traces the Sun like a Sun Flower. In the morning, panel is placed by facing the sun. As the sun changes its position, along this, panel also tilts to face the sun. This process will continue till the evening.Solar tracking mechanisms improve the energy gain of solar power plants. Standalone working and wireless communication is achieved with computer or mobile which makes the system reliable and observable. The use of LDR sensors and high precision voltage and current sensor guarantees a more accurate and efficient tracking system. It now displays the sensors Parameters to the User over the internet Using effective application and also alerts user when sensors

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parameters above specific limits. This makes remotely monitoring of solar plants very easy and ensure best Power output

VI. CONCLUSION

This project has presented an overland a simple control implementation of a sun tracker that employed double dual axis Dc motor to follow the Sun. Automatic solar tracking system is generally the one that reaches the highest energy gain in every region. It is therefore the most versatile system, since it can be installed anywhere, guaranteeing a high energy gain. Solar trackers are recommended everywhere from an energetic point of view, since they always increase the amount of collected energy. Two degrees of freedom orientation is feasible. Arduino Uno controller is used to control the position of DC motors which ensures point to point intermittent motion resulting from the DC geared motors.

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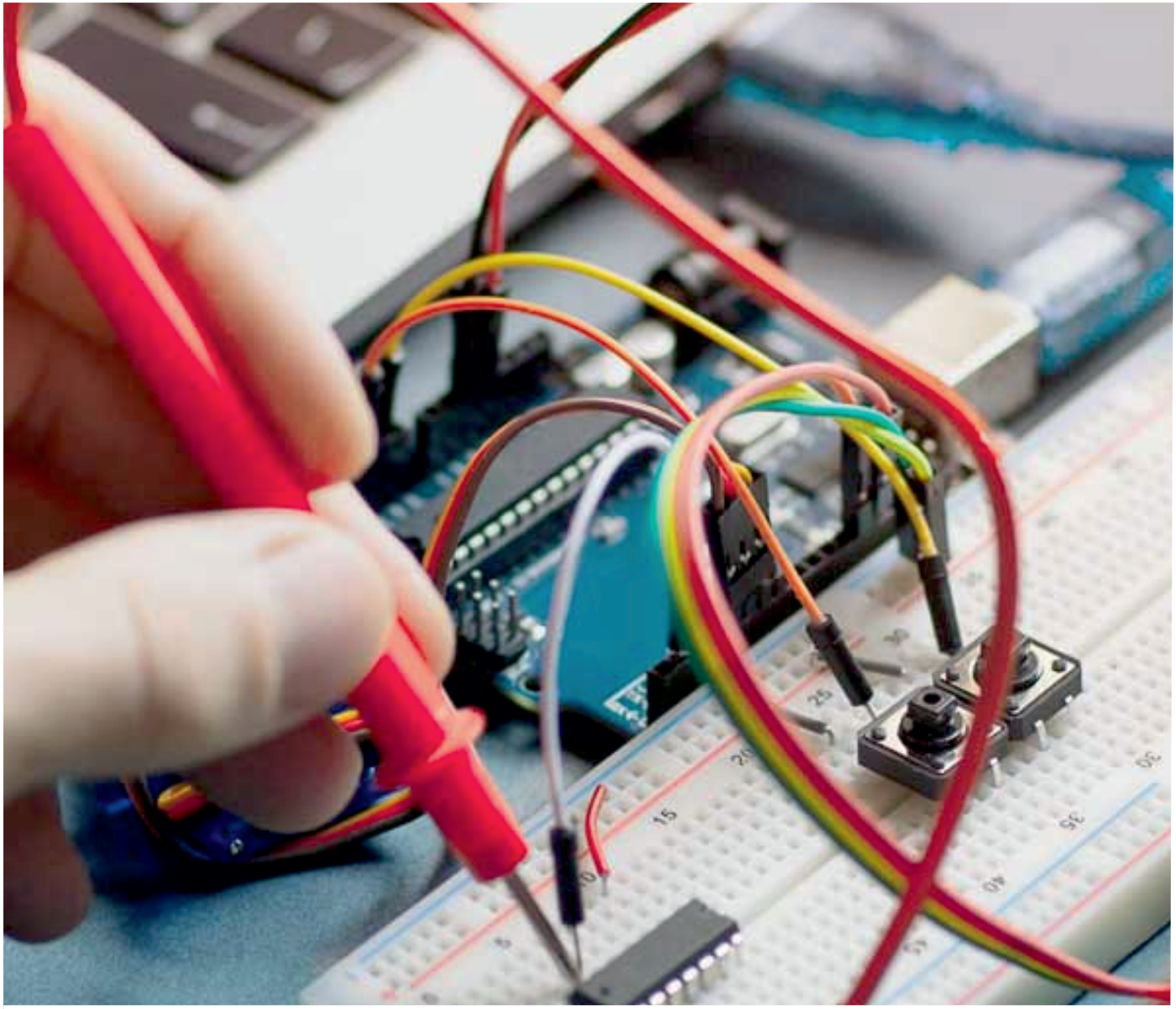

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