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Improving the Safety in Vehicles using Smart Black Box System

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ABSTRACT: Recently, the road accidents are increased due to various driving activities such as over speed driving, drunk driving and due to some malfunctions in vehicles. This paper involves with the development of a system called BLACK BOX in vehicles. It collects all the real time data regarding driving speed and vehicle status. These collected data are useful for police investigation, if an accident has been occurred. The real time data collected are such as whether the driver is drunk or not, drowsy status, seat belt status, motor temperature, gas leak inside the vehicle, distance between vehicles and vibrations in vehicles. These real time data have been collected by various sensors. Whenever the positions of the vehicles are changed from fixed position it is recorded by an accelerometer and the alarm will be given. If the values of the sensors are exceeded from the fixed value then the alarm gets activated. In case of any accident detection, the SMS will be transmitted to the police and relatives from the registered mobile number and also to the emergency service like an ambulance. In this paper, we had used GSM and GPS for mobile communication. By using this system, we can reduce the security risk for the severity and rescue time of the accident.

KEYWORDS: Black box system, GPS, GSM, Memory Storage device.

I.INTRODUCTION

The motorcycle accident could even be a big public problem in many countries. Despite awareness campaign, the problem remains increasing because of the rider's poor behaviours such as speed driving, drunk driving, riding without sufficient sleep, etc., The Number of deaths and disability are very high due to late assistance to the public that got the accident. This leads to huge social and economic burdens to the people involved. Therefore, to protect riders from accidental injuries, some research group and major motorcycle manufacturers have developed safety devices. However, good guard for motorcycle is difficult to implement and really expensive. Alternatively, intelligence schemes such as fall or incident detection with the tracking system have also recently been devised. This is to notify the accident to related people, so they can reach the people who met with an accident as soon as possible. Presently, the tracking system is simply installed in some high-end motorcycles because these systems are still too expensive for several motorcycle riders. Recently, fall detection and accident alarm for motorcycle has gained attention. These systems were expected to save human life by helping the riders to urge medical treatment on time. During this work, a wireless recorder using MEMS accelerometer and GPS tracking system is developed for monitoring accidents. Within the event of accident, the GPS system indicates the position of vehicle and then the wireless device will send short message to the beloved, Emergency Medical Service (EMS) and the nearest hospital so as that they'll be able to provide ambulance and prepare treatment for the patients.

II. OBJECTIVES

1. To prevent accidents on road.
2. To intimate the accident location to remote area users.
3. To know about the exact reasons for the accidents.
4. To track the vehicle when it is theft.

III. EXISTING SYSTEM

In the existing system, a prototype of the Automobile Black Box System was designed and implemented successfully. In case of accident the sensors are activated and data are recorded and also, message will be sent to the control room at the time of the accident.

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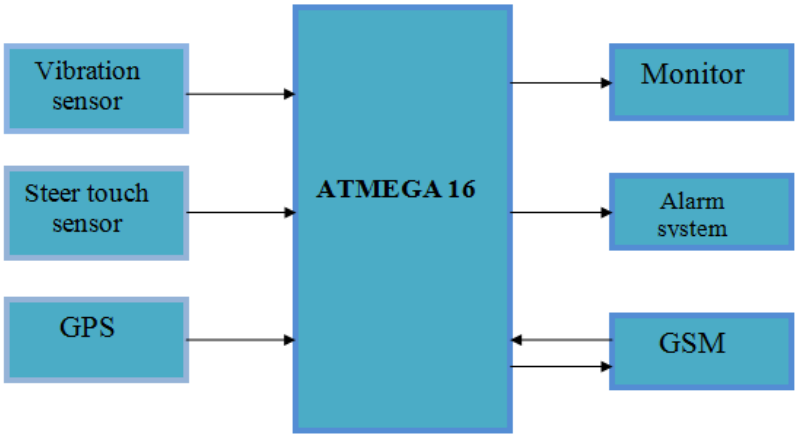

Fig .1 Block Diagram for Existing System

Consider a car had met with an accident automatically the sensor will get activated. The sensors outputs were communicated to the microcontroller. The data retrieved from the sensors are transmitted through IOT. ATmega16 is an 8-bit high performance microcontroller is used. This system consists of steer touch sensor, Hall Effect sensor and an android app was used. These sensors are used to detect the position of driver, vibrations occurred within car. When the accident occurs, the alert system is activated and short message is generated. In this system they have used GPS and GSM for detecting location and transmitting SMS to the control room. Once the call centre gets the car status it will search to find nearest police station, hospital, ambulance service and contact then to reach at the accident location to help the person. IOT is used for transmitting short messages, if the atmospheric condition is poor, the signals is also interrupted or gets disconnected, then the emergency service will be impossible and this is a drawback for this method.

IV. PROPOSED SYSTEM

In the proposed system, it detects the engine temperature, obstacle presences, acceleration, drowsy status, gas leakage, vibrations & seat belt check. The outputs of these parameters are displayed on the LCD.

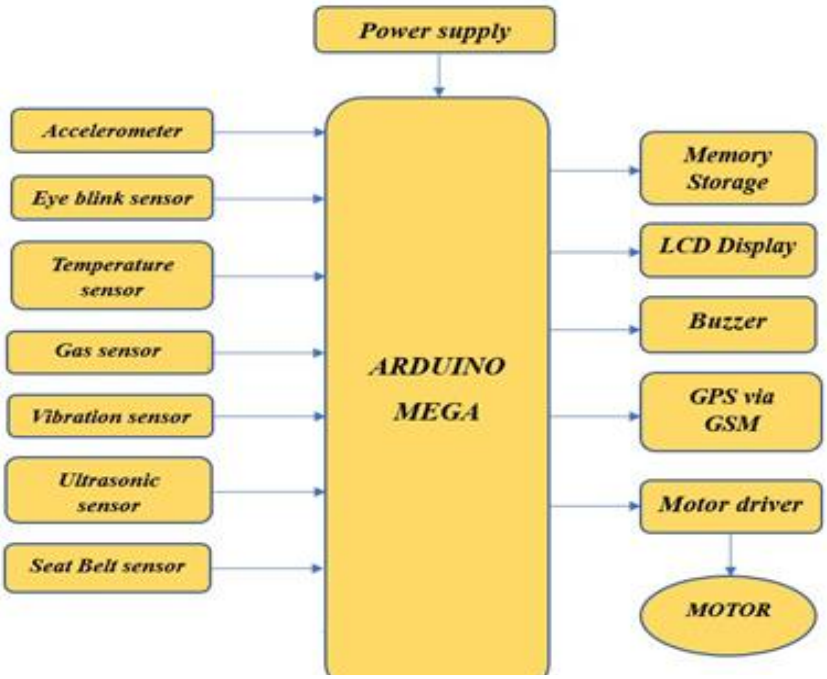

Fig .2 Block Diagram for Proposed System

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These collected information's are sent to the police server, ambulance through the GSM. GPS tracking system developed in this system helps to track the vehicle in case of an accident and enables authorities to extend immediate emergency, medical service and also helps to gather exact reason for accident, which is useful for police investigation.

1. POWER SUPPLY UNIT: In the power supply, LPC2148 works on 3.3 V power supply. For generating 3.3 V supply, LM75 is used. Transformer used in this system is used to step down 230V AC to 9V AC supply. Filter is used to reduce ripple factor of DC output from rectifier end. Rectifier converts AC supply into DC. Regulator is used to regulate DC supply output.

2. ACCELEROMETER: The accelerometer (MEMS) itself is just an analog transducer designed to output an electrical signal proportional to input acceleration. MEMS accelerometers are usually lower range and high sensitivity devices. It is used for structural monitoring and constant acceleration measurements. MEMS accelerometer contains a built-in voltage regulator and it may also be powered using any 6 to 30V DC power source without adversely affecting the performance. MEMS accelerometers can measure constant (static) acceleration and therefore the DC offset voltage will get affected due to the positional alignment relative to the Earth's gravity. When the sensitive axis of the accelerometer isn't aligned with gravity at that point the output will equal the zero-g offset voltage on the PCB calibration certificate. If the sensitive axis of the accelerometer is aligned with gravity, the output will be equal to the bias voltage plus 1g of output.

3. EYE-BLINK SENSOR: By the illumination of eye and eyelid area with infrared light, the Eye-blink sensor works. In this system it is used to check the drowsy status of the driver. A phototransistor and differentiator circuits are used to monitor the changes in the reflected light. The eye gets illuminated by an IR led powered by the +5v power supply. An IR photo diode records the reflected light. The variation across the eye will vary with respect to eye blink. The output is high, when the eyes are closed and low (o/p), when open.

4. TEMPERATURE SENSOR: Temperature sensor (LM35) is a device for measuring the temperature via an electrical signal and a thermocouple or RTD (Resistance Temperature Detectors) is required. Temperature sensor is used in this system to detect the temperature of the engine and to avoid damages in the engine during over drive.

5. VIBRATION SENSOR: The vibration sensor is also known as piezoelectric sensor. This sensor is a flexible device which is used to detect the force applied on the vehicle. In this sensor, the normal sensitivity ranges between 10mV/g and 100mV/g. And also, lower and higher sensitivities are accessible.

6. ULTRASONIC SENSOR: The Ultrasonic sensor (SCSR04) output (ECHO) will always have a low output (0V) unless it has been triggered during this case its output will be 5V. In this system it is used to detect the distance between the objects and shows the result in centimetres. For detecting the ECHO voltage change, we need to set one GPIO pin as output and one as input to trigger the sensor. By a trigger mechanism, this device is activated. The distance to an object can be found by pressing the trigger for one time if there was no error like poor aiming.

7. SEAT BELT SENSOR: The Seat belt sensor is used to detect whether the driver has worn Seat belt or not. If not, the alarm is activated and warns the driver. It is also recorded. When a person sits on the seat, the pressure sensor signals the occupant's weight to ECU. The ECU sends those data to the airbag, which is of its own control unit. Based upon the information, the vehicle's computer turns on or off the passenger's airbag. The OCS does not just detect weight.

8. GAS SENSOR: The Gas sensor MQ3 is a simple-to-use Liquefied Petroleum Gas (LPG) sensor, suitable for sensing LPG (composed of mostly propane and butane) concentrations in the air. It can able to detect gas concentrations anywhere between 200 to 10000 ppm and also the attentiveness of alcohol gas within the air. In this system it is used to detect whether the driver is drunk or not and also gas leak within the vehicle.

9. LIQUID CRYSTAL DISPLAY (LCD): A flat-panel display or an electronic visual display, which uses light-modulating properties of liquid crystal, is known as liquid-crystal display (LCD). These liquid crystals do not emit light directly. For displaying arbitrary images or fixed images with low information content, LCD's are available. Such as pre-set words, digits and 7-segment displays in a digital clock, it can be displayed or hidden. In this paper it is used to display the distance between vehicles, temperature of engine, etc.

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10. GLOBAL POSITIONING SYSTEM (GPS): A GPS receiver's job is to locate four or more of those satellites, find out the space and use this information to deduce its own location. This operation is predicated on an easy mathematical principle called trilateration. GPS receiver calculates its position on earth supported the knowledge it receives from four located satellites.

11. GSM MODULE: The GSM module is programmed in such a way that when the latitude and longitude from the GPS module is sent by the Arduino to the GSM module. In the form of an SMS, it will be able to send that particular latitude and longitude to the pre-coded number.

12. MOTOR DRIVER: A motor driver acts as an interface between the motors and therefore the control circuits. Motor require high amount of current. But the controller circuit works on low current signals. So, the function of motor drivers is to require a low-current control signal then turn it into a higher- current signal which will drive a motor. Motor drivers act as current amplifiers since they take a coffee current control signal and supply a higher-current signal. To drive the motors, higher current signal is employed. The motor operations of two motors are often controlled by input logic at pins 2 & 7 and 10 & 15. Enable pins 1 and 9 (corresponding to the 2 motors) must be high for motors to start out operating.

13. MOTOR: The gear motor is employed to maneuver robot "Gear motor" refers to a mixture of a motor plus a discount gear train. With a corresponding increase in torque, the gear reduction (gear train) reduces the speed of the motor. A small ratio is often accomplished with one gear pair, while an outsized ratio requires a series of drugs reduction steps and thus more gears. A geared DC Motor features a gear assembly attached to the motor. Using the right combination of gears during a gear motor, its speed is often reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is understood as gear reduction. This will explore all the major and minor details that make the gear head and hence the working of geared DC motor.

14. ALERT SYSTEM: In this system alarm is used for giving alert when the values of sensors exceeded. The buzzer is used for alarm. A buzzer or beeper (an audio signalling device), that may be mechanical, electromechanical, or piezoelectric. The alarm gets activated under these conditions, when the distance measured by ultrasonic sensor is less then specified range, when the driver feels drowsy, vibration occurred within vehicle, gas leak within vehicle, if driver is drunk, if seat belt is not worn, if engine temperature exceeds the specific range.

15. BLACK BOX SYSTEM:
The car black boxes are also known as video data event recorder which is used by the drivers voluntarily. These are installed on the windshield and feature a camera as well as a GPS unit and collect the performance data such as accelerating, braking and turning. The data is stored automatically to a SD (secure digital) card similar to those which are used in digital cameras and it can be reviewed on a computer. This type of car black boxes is even more accurate compared to those that are currently being installed in vehicles because it also records the time, location and direction of the driving as well as the driver's view.

16. METHODOLOGY: When an accident occurs, the microcontroller gets activated and starts collecting the information such as temperature, the presence of obstacle, acceleration and set belt check respectively from the sensors. The GPS module, GSM module, limit switch, relay, gas sensor and the temperature sensor are connected to the Arduino board. The GPS antenna repeatedly collects the location of the vehicle. Therefore, the GPS module continuously sends that location to the Arduino (in terms of latitude and longitude). At the time of system installation, the registration number of vehicles along with relative's phone number, emergency services number feed into the source code of the system. The GSM module is programmed in such a way that when the latitude and longitude from the GPS module is sent from the Arduino to the GSM module, it will be able to send that particular latitude and longitude to the pre-coded number in the form of an SMS. Consider a car had met with an accident, automatically the sensor will get activated and start its surveillance mode. If user is not in critical condition and can help himself then he will stop surveillance mode within given time period else system will consider user need assistance and start auto contacting with call centre and specified person. When the assistance mode is started, initially the system gathers the car location using GPS device in the form of longitude and latitude. Then, it will record car details like car owner details, car number, car model, car speed if possible and convert this data in to format SMS. This data is sent to call centre and person's relative where person need to provide contact person details manually before starting drive. When the call centre gets the car status it will find nearest police station, hospital, ambulance service and inform then to reach at accident location to help the injured person. The real time data are collected by various sensors are stored in black box, which can be used for police investigation and also for future uses.

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V. RESULT AND HARDWARE DESCRIPTION

In Proposed model we have used various sensors such as Eye blink sensor (drowsiness), Accelerometer sensor (MEMS), Seat belt sensor (IR), Temperature sensor (LM35), Gas sensor (MQ3), Vibration sensor (SW420), Ultrasonic sensor (SCSR04) and Motor driver (L293D). Arduino 28 pin microcontroller is used. LCD (liquid crystal display - HD44780), GPS (global positioning system), GSM (Global Standards for Mobile Communication), Buzzer, Memory storage device (SD Card) are used in our paper. Temperature sensor is used in this paper to detect the temperature of the engine and to avoid damages in the engine during over drive.

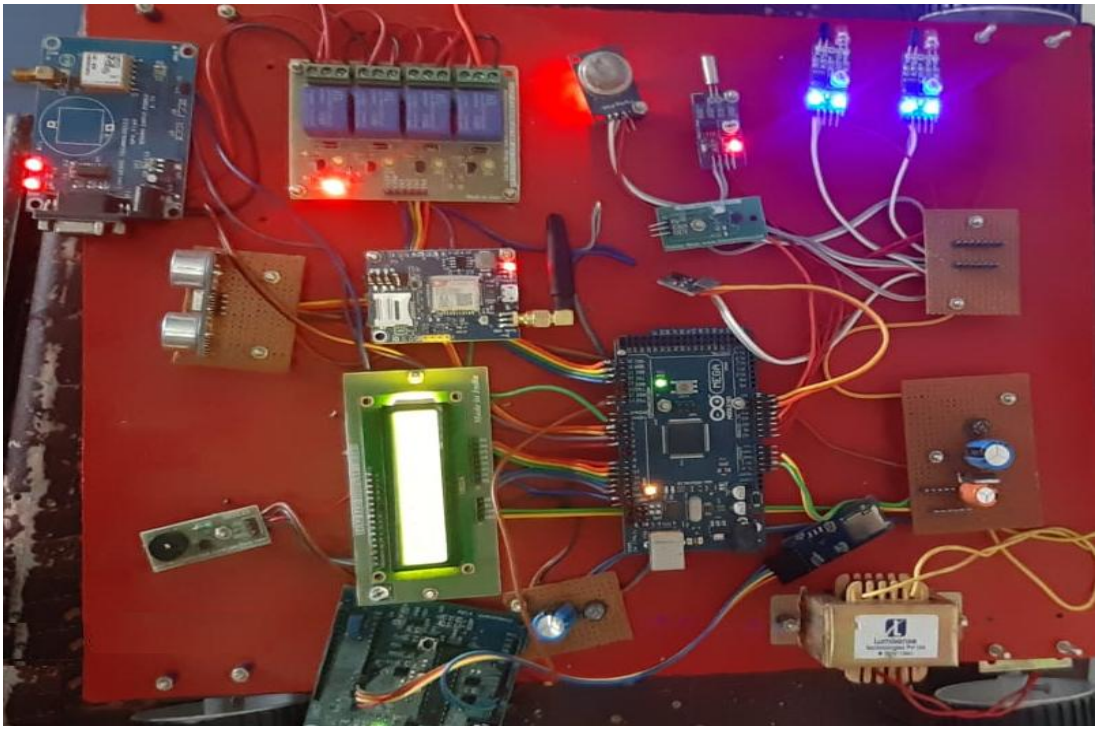

Fig. 3 Overall Hardware of the Proposed System

Eye blink sensor is used to check the drowsy status of the driver. Ultrasonic sensor detects distance between the objects and it shows the result in centimetres. The Seat belt sensor is used to detect whether the driver has worn, Seat belt or not. The vibration sensor is also known as piezoelectric sensor. This sensor is a flexible device which is used to detect the force applied on the vehicle. The Gas sensor MQ3 is used to detect any gas leak within the vehicle and checks out whether the driver is drunk or not. The various data collected from these sensors are stored in memory storage device. The memory storage device act as a Black box system. The data are collected such as position of car, vibrations, gas leak within the car, whether driver is drunk or not, distance between the car and surrounding objects, drowsy status, seat belt status, temperature of motor. LCD is used to display the collected data from various sensors, it is fixed within the car. When the fixed values of these sensors are exceeded the alarm gets activated.

VI.CONCLUSION

The Smart Black Box system is successfully implemented in vehicles by using Arduino which had given required results and expected functioning. The black box system is an important device for the investigation of car accidents. We can easily retrieve the data from this Smart Black Box system. In this paper the memory storage device acts as a black box system. By recording the events and actions of the driver including speed, intake of alcohol and also the position of vehicle, gas leak, etc., till the seconds before the accident, the car black box will helps the police for investigation and also helps to save human's life by transmitting the short message to emergency service as soon as accident has occurred. In this paper we have used various advanced sensors and alarm systems to intimate various actions such as gas leak within car, seat belt condition, obstacles, etc., This paper is conducted about the event data recorder and to ensure the safety for drivers. It will also bring a number of benefits for the car's owner and police. It also plays a vital role in reducing road accidents.

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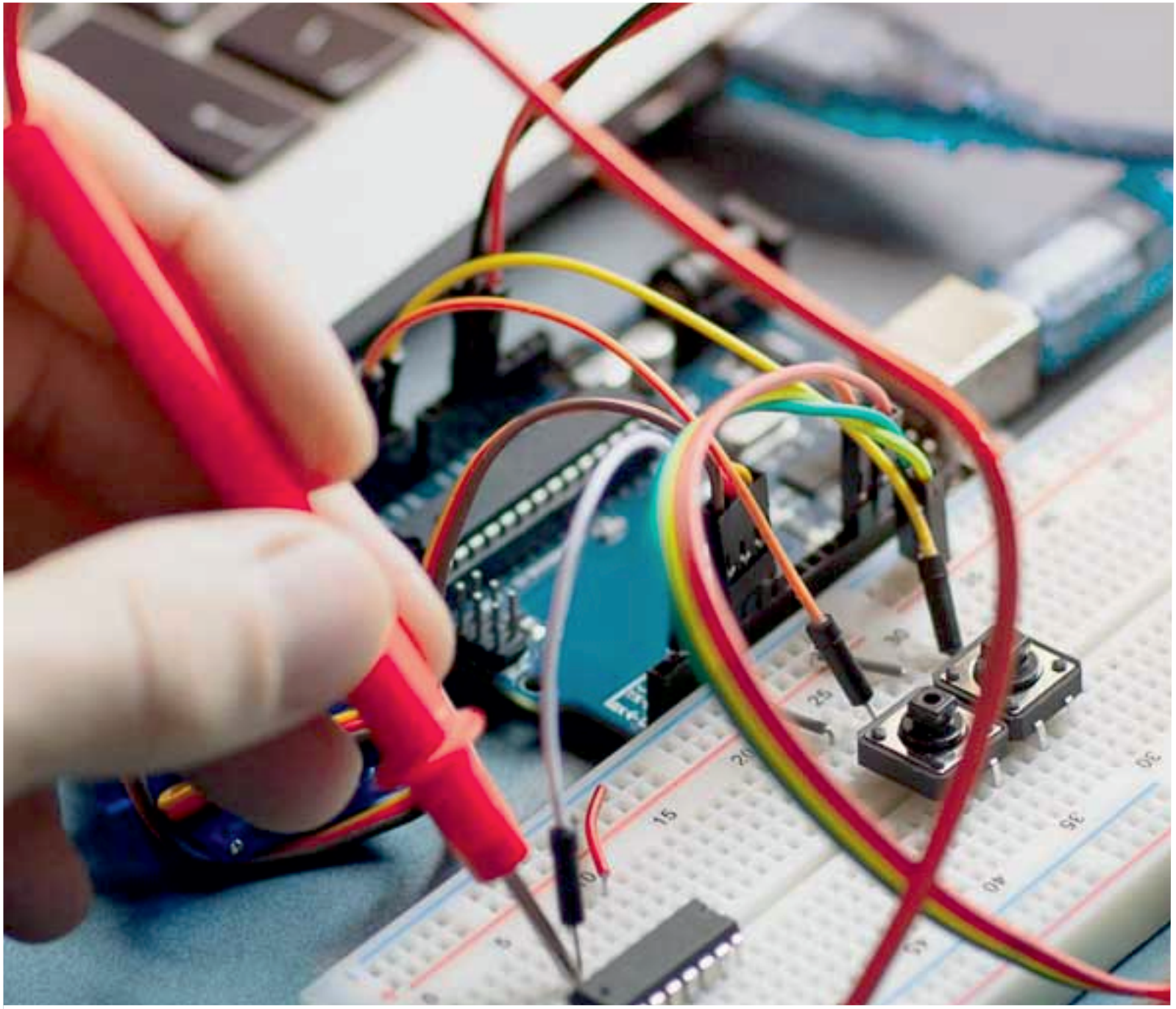

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