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Artificial Intelligence Based Traffic Signal Control System

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ABSTRACT: Traffic congestion is the biggest problem faced by densely populated countries like India, China etc. So, our project focuses on three areas-Ambulance, Priority and Traffic density control. The main purpose of our system is the smooth movement of cars along the transport line. Integrating a system with multiple traffic lights into an existing system is a complex task. There is no common abstraction between traffic light systems, vehicle deviation, high red light delay, vehicle drift, accident, emergency vehicle and pedestrian crossing In the first part, concentrated on problems faced by Ambulances, RFID concept is used to make the Ambulance's lane Green and thus providing a stoppage free way for the Ambulance. In the second part, concentrated on problems faced by Priority vehicles, IR transmitter and receiver are used to make the vehicles' lane Green and thus preventing traffic congestion. In the third part, concentrated on Traffic density control, IR transmitter and receiver are used to provide dynamic traffic control and thus increasing the duration of the Green light of the lane in which traffic density is high and hence, regulating traffic.

KEYWORDS: Traffic Density, Ambulance, Arduino MEGA, IR sensor, RFID reader writer module

I. INTRODUCTION

The traffic issue is extremely muddled because of the contribution of assorted parameters. In the first place, the traffic flow depends upon the time where the traffic top hours are for the most part early in the day and toward the evening; on the times of the week where ends of the week uncover least load while Mondays and Fridays by and large show thick traffic arranged from urban communities to their edges and in turn around bearing individually; and time as occasions and summer. Also, the current traffic light system is executed with hard-coded defers where the lights change schedule slots are settled routinely and don't rely upon continuous traffic flow. The third point is worried about the condition of one light at a crossing point that impacts the stream of movement at neighboring convergences. Additionally, the traditional traffic system does not think about the situation of mischance, road works, and breakdown vehicle that compound movement blockage.

II. LITERATURE SURVEY

Topic : AI BASED TRAFFIC SIGNAL CONTROL SYSTEM

This paper presents a strategy for evaluating traffic systems using image processing. This is eliminated when using images taken from a carriage or tape, and recorded images are moved into a series of images. Each picture is prepared independently and the number of the vehicle is collected. If there is no chance that the number of vehicles will exceed the established limit, a notice of significant movement will be indicated automatically. In the proposed system, the key feature is ambulance priority.

Topic : INTELLIGENT TRAFFIC LIGHT CONTROL SYSTEM (ITLCS)

This paper presents a project to eliminate the delay on roads by reducing traffic on road automatically using embedded system. It determines traffic on each road by using sensors. Using that traffic information we can manage

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the signal time and handle the traffic on road. On each road we place IR sensors which detect the vehicle and give current traffic information on each road. The timing of signal is adjusted according to traffic level on each road. The road which has level more than other road then this road assign green signal and for others have red is assign. It is also provide the additional functionality of release the emergency vehicle on its occurrence that means when emergency vehicle occur

Topic: AI Planning Based Modeling Method for Area Traffic Signal Control

In this paper an area signal control model based on temporal planning is presented. Every activity of area signal control is modeled using planning domain definition language, and then the domain model of area signal control is established. Aiming at the representation problem of resource and time in the area signal control model, we extended the basic activity model by adding resource constraint and temporal constraint, and temporal planning based domain model for area signal control is established finally.

III. PROPOSED WORK

The main purpose of our system is the smooth movement of cars along the transport line. Integrating a system with multiple traffic lights into an existing system is a complex task.

A. *Hardware Design*

There are two units of the monitoring system: IR sensor and RFID Reader. The unit includes Arduino Microcontroller,Sensors like IR sensor and RFID reader as shown in the block diagram.

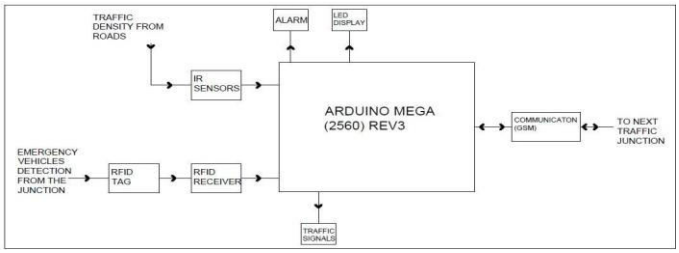

Fig. 1: Block Diagram

B. *Arduino Microcontroller*

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

TABLE I. Specifications

Specification	
Microcontroller	Atmega2560
Operating Voltage	5v
Input Voltage (Recommended)	7-12V
Input Voltage (Limit)	6-20V
Digital I/O Pins	54 (Of Which 15 Provide Pwm Output)
Analog Input Pins	16
DC Current Per I/O Pin	20 Ma
DC Current For 3.3V Pin	50 Ma
Flash Memory	256 Kb Of Which 8 Kb Used By Bootloader
Sram	8 Kb

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Eeprom	4 Kb
Clock Speed	16 Mhz
Led_Builtin	13

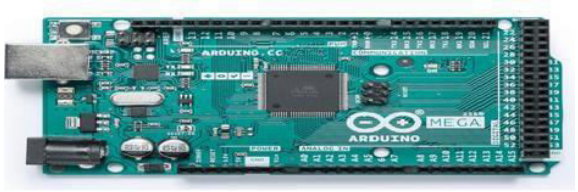

Fig. 2:Arduino microcontroller Mega

C. IR Sensor

IR sensor is an electronic device that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode. Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

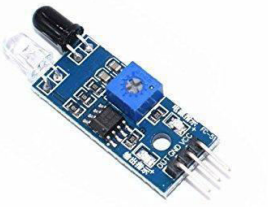

Fig 3: IR Sensor

D. RFID Reader Writer Module

The NSK125 series RFID Proximity OEM Reader Module has a built-in antenna in minimized form factor. It is designed to work on the industry standard carrier frequency of 125 kHz. This LF reader module with an internal or an external antenna facilitates communication with Read-Only transponders—type UNIQUE or TK5530 via the air interface. The tag data is sent to the host systems via the wired communication interface with a protocol selected from the module Both TTL and Wiegand Protocol. The LF module is best suited for applications in Access Control, Time and Attendance, Asset Management, Handheld Readers, Immobilizers, and other RFID enabled applications.

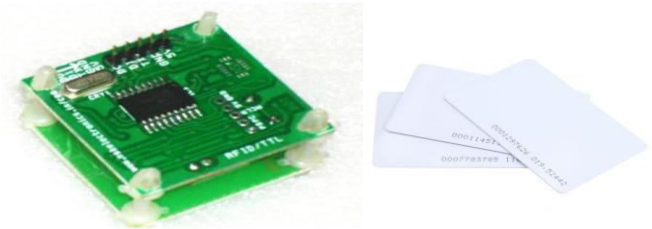

Fig. 4: RFID Reader and Writer

Features

- Output- TTL or Wiegand26
- Plug-and-Play, needs +5V to become a reader
- Buzzer indicates tag reading operation
- Compact size and cost-effective

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E. SIM800L GSM GPRS MODULE

SIM800L Module is a miniature cellular GSM/GPRS breakout board that allows GPRS transmission, sending and receiving messages and making and receiving calls. This module supports quad-band GSM/GPRS network, which is available for GPRS and SMS data remote transmission. The board features compact size and low current consumption. With power saving technique, the current consumption is as low as 1mA in sleep mode. It communicates with microcontroller via UART port, supports command including 3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands. It also has built-in level translation, so it can work with microcontroller of higher voltage than 2.8V default. Besides, the board also supports A-GPS technique which is called mobile positioning and gets position by mobile network.

Fig 5: GSM Module

F. Voltage Regulator

A voltage regulator is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

Fig 6: Voltage regulator

G. LCD Display

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pin outs have already been visualized above now let us get a bit technical.
Features of 16×2 LCD module

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Operating Voltage is 4.7V to 5.3VCurrent consumption is 1mA without backlight Alphanumeric LCD display module, i.e. can display alphabets and numbers Consists of two rows and each row can print 16 characters. ach character is build by a 5×8 pixel box Can work on both 8-bit and 4-bit mode It can also display any custom generated characters Available in Green and Blue Backlight

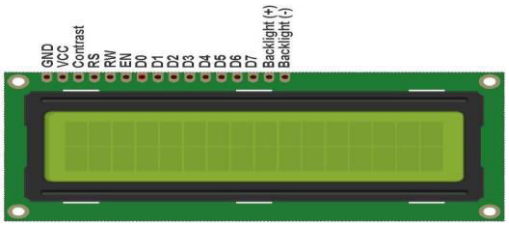

Fig 7: LCD Display

H. LEDs

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

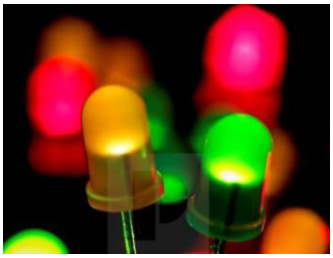

Fig 8: LEDs

I. Power Supply (12v Adapter)

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply). All power supplies have a power input connection, which receives energy in the form of electric current from a source, and one or more power output connections that deliver current to the load. The source power may come from the electric power grid, such as an electrical outlet, energy storage devices such as batteries or fuel cells, generators or alternators, solar power converters, or another power supply. The input and output are usually hardwired circuit connections, though some power supplies employ wireless energy transfer to power their loads without wired connections. Some power supplies have other types of inputs and outputs as well, for functions such as external monitoring and control.

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Fig 9: Power Supply Adapter

J. Arduino IDE

The Arduino incorporated improvement environment (IDE) is a cross platform application (for Windows, macOS, Linux) this is written within side the programming language Java. It is used to put in writing and add applications to Arduino well suited boards, however also, with the assist of third birthday celebration cores, different dealerimprovement boards.

The supply code for the IDE is launched below the GNU General Public License, model 2. The Arduino IDE helps thelanguages C and C++ the usage of unique regulations of codestructuring. The Arduino IDE elements a software program library from the Wiring project, which affords many not unusual place enter and output procedures.

Fig. 4: Arduino IDE

IV. IMPLEMENTATION

A. Circuit Diagram

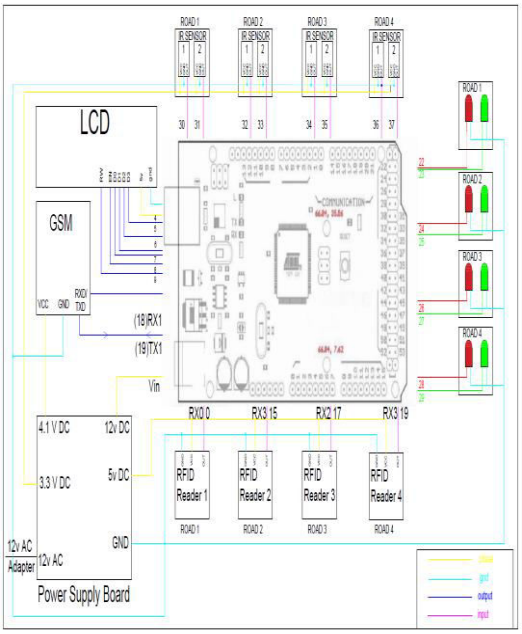

Fig. 4: Arduino IDE

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B. Description

1. Arduino MEGA, which controls the sensors to capture the traffic density according to the distance acquired by the vehicles. On the other hand Arduino also communicates with RFID tag for emergency vehicle detection.

2. The Arduino stores the info from the sensors and execute according to the priority of each distance at the junctions to determine traffic density. Traffic density must be determined for each road section.

3. A line or path with a higher traffic density receives a first priority (more time delay for green signal), and a path with a lower traffic density is the lowest priority(less time delay for green signal).

4. The road is selected in order of sequence i.e. Road 1 – Road4

5. The time of each signal depends on the OUT bands or traffic density in descending order.

6. When all the lane or route has given the green signal based on their priority the traffic system complete its one cycle.

7. In parallel with this if any of the RFID tag is activated with emergency vehicle detection, the message is sent to the microcontroller to stimulate the traffic lights of that particular with green light for ten seconds and making the free running mode to emergency vehicles.

8. In addition to this GSM sends the emergency message to next junction stating that the previous junction is detected with the emergency situation.

9. The GSM on the next junction receives the message and sends to microcontroller where is stimulate the message and controls the signal(i.e. lights) accordingly.

10. This process will be repeats and time for all signals will be given on the basis on traffic density.

C. Flowchart

Step 1- Take input from the sensors
Step 2- Regulate the info from the sensors Step 3- Stimulate the traffic lights
Step 4- If emergency situation detected indicate through buzzer and LED display Step 4- Communicate between the other junction
Step 6- Get the feedback from the other junction

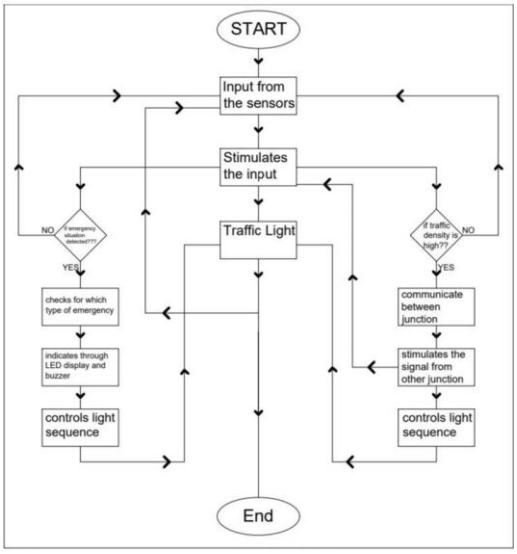

Fig. 11: Flowchart

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V. RESULTS

A. Testing of Traffic Density Measurement

The module was tested for the traffic density measurement using IR sensors. The sensors which are placed at certain distances in each road are activated successfully when the density for traffic is respected to that sensor. The info from the sensor is collected from the microcontroller and the microcontroller stimulates the traffic lights resulting in green light at the signal.

B. Testing of Emergency Vehicle Detection

The module was tested for the emergency vehicle detection using RFID reader. The RFID Reader module is kept at the starting of the junction. The emergency vehicle (i.e. RFID Writer) made pass through that for detection. The module detected the vehicle and sends the info to the microcontroller. The microcontroller studies the info and stimulates the traffic lights to green for 10 seconds irrespective of the sequence of the traffic lights. And the message displayed on the LCD stating the emergency vehicle at particular road and the signal count.

C. Testing of Communication between the Junctions

The module was tested for communication process between the junctions using GSM (SIM 800L). Once there is emergency vehicle detection in the junction the microcontroller sends a quoted text to the GSM to the send that message to next junction. The GSM successfully sent the message and the message is received form next junction GSM and microcontroller studies the message and stimulate the traffic lights for free running path for emergency vehicle.

Fig. 12: Project Prototype

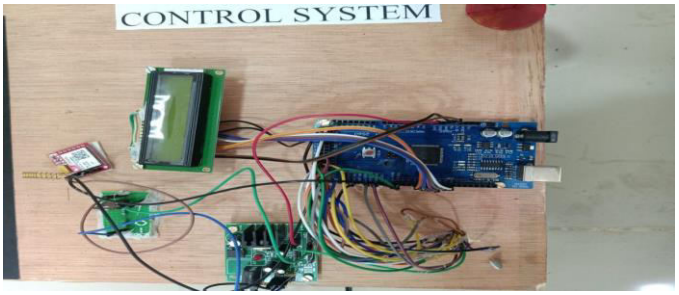

Fig. 12: Project Control System

VI. CONCLUSION

In this project we introduced sensor based technology for traffic control. We conclude that it provides powerful solution to improve existing system with the new intelligent traffic light controller.
This project has two major phases

- Blinking of traffic signal light according to the traffic level present on the road.

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• This system manages traffic when any emergency vehicle comes. For example ambulance, fire bridged etc. Proposed system will have wider future scope that user can get traffic information on mobile phone.

VII. FUTURE SCOPE

i. This project can be enhanced in such a way as to control automatically the signals depending on the traffic density on the roads using sensors like IR detector/receiver module extended with automatic turn off when no vehicles are running on any side of the road which helps in power consumption saving.

ii. Traffic lights can be increased to N number and traffic light control can be done for whole city by sitting on a single place.

iii. In ambulance system, the data of the patient in the ambulance can be sent to the Hospitals via GSM technology. Thus, it can provide early and fast treatment of patient.

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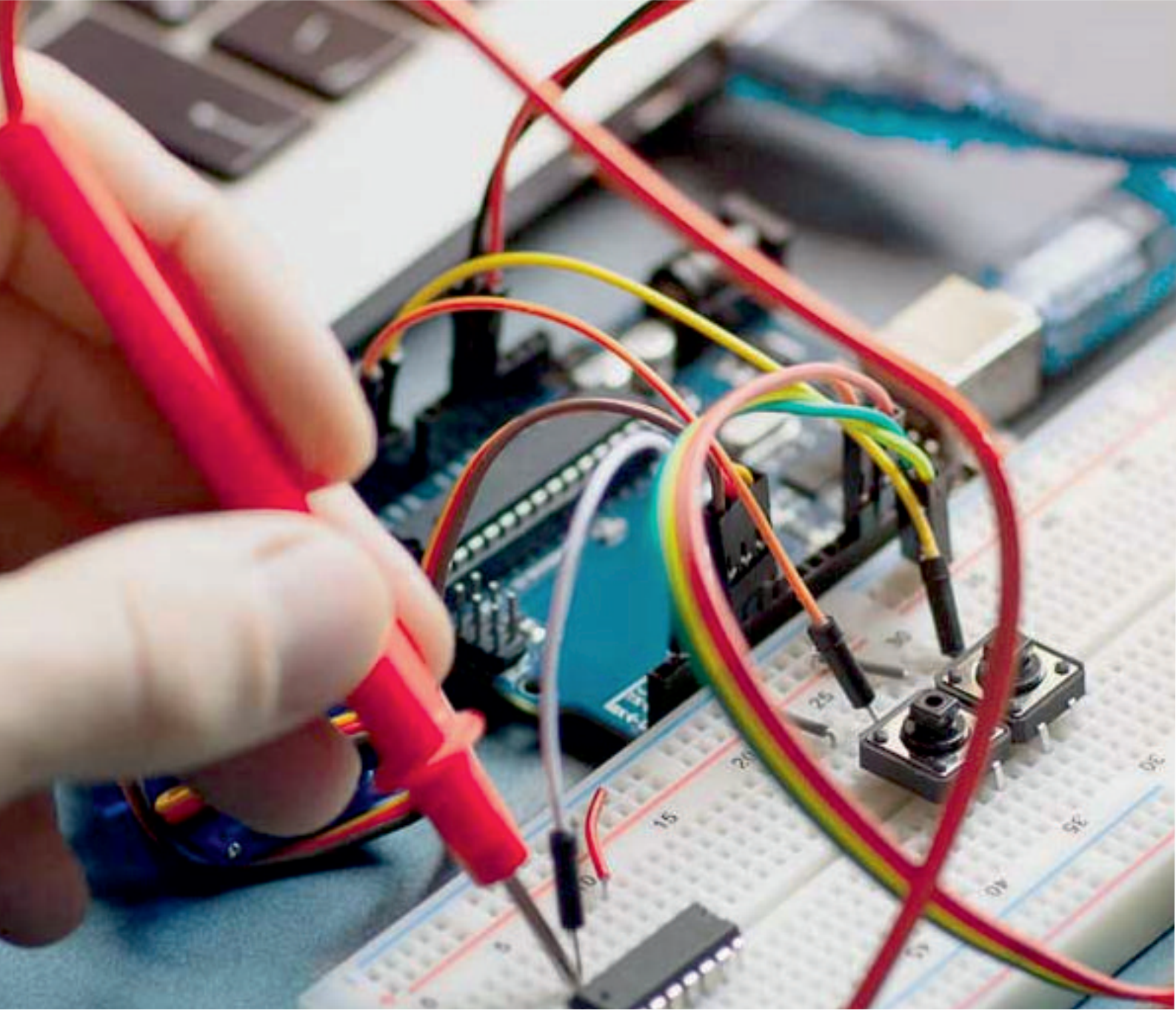

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