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# Home Automation Using IOT

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**ABSTRACT:** With the increase in consumption of energy and population, we need to conserve our energy in every way possible. The ability to access and control the equipment from remote locations is one of the major reasons for energy loss. The users to give instructions to these systems use a voice or an android application. This system can make use of a host of communication methods such as Wi-Fi, GSM, Bluetooth, ZigBee. Different controlling devices and configurations can be found in active systems. Such systems are present already in many places for a wide variety of equipment. This paper presents a survey of all such systems.

General Terms -Embedded Systems, Remote access Systems, Mobile Applications, Web Applications and Home Automation System

**KEYWORDS:** Energy Conservation, Raspberry Pi, Portability, Physically Challenged, Electrical and Electronic Devices, Home Automation.

## I. INTRODUCTION

The concept of Internet of things(IoT) was introduced by the growth of the widely used global network known as the internet along with the deployment of ubiquitous computing and mobiles in smart objects which brings new opportunities for the creation of innovative solutions to various aspects of life. The concept of Internet of things(IoT) creates a network of objects that can communicate, interact and cooperate together to reach a common goal.IoT devices can enhance our daily lives, as each device stops acting as a single device and become part of an entire full connected system. This provides us with the resulting data to be analyzed for better decision making, tracking our businesses and monitoring our properties while we are far away from them. As the paradigm of IoT is growing, it is stepping into every aspect of our lives. This leads to an easier life through wider range of applications, such as electronic health care solutions and Smart city concept. The concept of Smart city aims to making a better use of resources, increasing services quality offered to the citizens, and reducing costs of the public administrations.

The paper will also compare and contrast all the systems and look at their various features and disadvantages. A wide variety of options are available for the home automation systems. All of these will be examined at length.

## II. METHODOLOGIES

### 2.1 GSM based Home Automation System

The system proposed 3 means to control to the home: the GSM network, the Internet and through speech. The real time monitoring has been an important feature that can be used in the home automation systems. As a change in the status of the devices occurs, the user can be informed in real time. The user commands are transferred to a server which is usually done by a PC. The server processes the user commands and sends them to the relevant units. This can help control the appliances. GSM is used as a communication medium to help establish connection in places where there may not be proper internet connectivity. The server uses AT commands to communicate with the GSM modem. The mobile interface is developed using J2ME. The server has 4 engines running – the web server, database, main control program and speech recognition program. The system can be controlled using SMS. It can send confirmation messages. Speech processing is done with a dynamic time wrapping algorithm. The voice activation has been tested and found to be too impractical. As a more stable alternative, the voice input can be activated through a wireless unit



the user carries along in the house. Each application node has four parts – the transmitter, receiver, I/O device and a microcontroller. The main control program in the server takes status information from the devices' transceiver in real time

The system makes use of a PIC16F887 microcontroller for home appliances control [2]. It makes use of GSM for control of the appliances. This is an SMS based system. GSM has been used due to its high availability, coverage and security. The control of home appliances is done primarily through SMS codes. AT commands can be sent through the GSM network and this controls the home devices. Messages are sent by the device to the user through SMS as well. This system can however incur additional costs for the SMS. There is no UI that the user can use to control the device. This system has the drawback of not being able to program the devices. Also SMS depends on the networks and there is a possibility of delayed delivery. The system does not have any state information related to the devices and expects the user to keep track of it.

The system [3] is described as an M2M system. It uses GSM for communication. GSM offers options for M2M which include Dual Tone Multi Frequency (DTMF), SMS and General Packet Radio Service (GPRS).

This system chooses to use the SMS along with AT (attention) commands. It has a PC as a centre of commands. A GSM dial-up and communication system is embedded in the PC. Visual C++ is used for implementation. The PC decodes the received messages via SMS and performs the commands required. It is a system that can be programmed for the required application as per requirements. The system also has the ability to control mechanical appliances, through sensors that convert electrical to mechanical signals. However, this system is not designed to provide feedback to the user. The system is PC centric and requires the PC to be on all the time. It cannot be used as a real time control system.

The home server is built upon a SMS/GPRS mobile cell module and a microcontroller [4]. This allows the user to monitor and control any appliances at home using any Java enabled cell phone. The paper presents the design and implementation of AT modem driver, text based command processing software and power failure resilient output from the microcontroller. The mobile phones are used to provide a user friendly interface. They also serve to send commands and receive feedback from the system as SMS strings. The hardware components include an Atmel microcontroller, which is connected with a RS232 serial port. It also has EEPROM memory to ensure that the relevant details are stored. A password based authentication system has to be used. The text messages sent will contain the password which is used to ensure the message is sent from a valid source. The main drawback of this system is that it relies heavily on the SMS, which is not very fast and dependable. There can be delays in delivery. Also security of the system is compromised since passwords are sent freely over the network.

A voice control system is proposed [6] that will enable the elderly and disabled to control appliances remotely. The primary communication means is through GSM. An Android mobile phone is used to get the voice commands and converts them into text. This is sent via SMS to another phone through the GSM network. This other phone uses Bluetooth and sends the text commands to the Bluetooth module. This module is connected to a microchip controller of the PIC16F877A family. This controller interprets the commands and performs the appropriate actions. The control of electrical circuits is done with a separated system, to isolate the load from the control circuitry. The system also sends back feedback to alert the user about the result of the command. This system's voice command feature makes it universally accessible. However the usage of SMS makes it unreliable. Also the necessity of two phones, one with the user and another in proximity to the controller can lead to additional expenses.

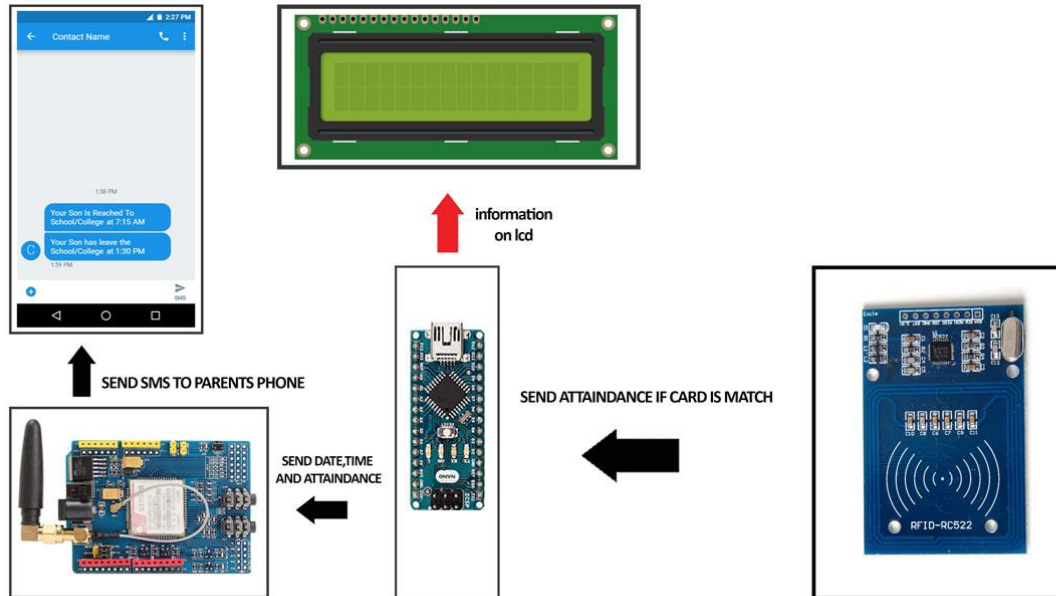


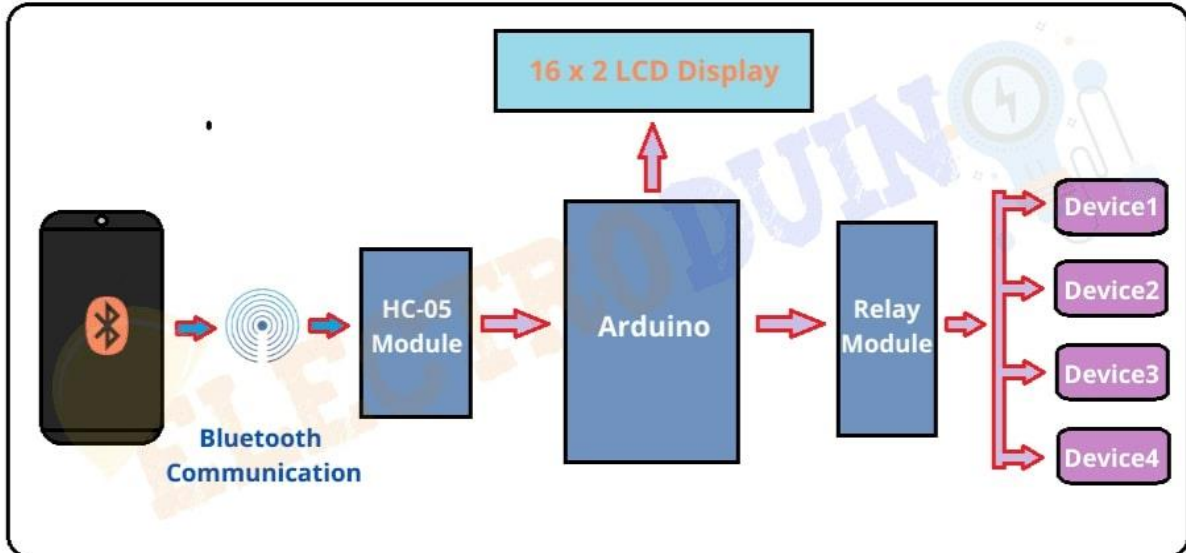
Figure 1 GSM based HA

A system [7] uses the GSM network along with an AVR microcontroller. This is also an SMS based system. The user enters the commands. These are sent via SMS. However, this A system based on GSM network via SMS [5] is used to control the home appliances as shown in figure 1. An Arduino board is the controller used to interface the appliances. It uses certain peripheral drivers and relays to achieve this interfacing. The smart phone is the user interface device. The system uses the ‘App Inventor’ visual programming tool to develop the interface and other tools to deploy the app. The app generates SMS messages based on the user commands and sends it to the GSM modem attached to the Arduino. This allows the user to control the home appliances. The system suffers from the same drawbacks of cost and reliability of SMS. Also the interface is pre programmed and cannot be customized based on devices. system uses a standardized AVR code that can be easily interpreted by the microcontroller. There is a GSM module that is attached to the AVR. This will receive the commands that are sent via SMS. AT commands are used to communicate with the modem. The AVR in turn instructs a driver circuit to control the appliances as necessary. This system has remote access capabilities from all over the world. However it cannot function in real time

A PIC16F887 microcontroller along with GSM [8] can form a home automation system. The commands are sent from the mobile phone via GSM to the GSM modem. This command is converted to text and sent to the controller through a RS-232 bus. These commands are interpreted by the microcontroller and the corresponding action is performed. The drawback of this system is that it requires external power supply. Also, it cannot control multiple appliances concurrently. The system cannot verify the status of the appliances at a time

## 2.2 Bluetooth Based Home Automation

The system shown in figure 2 makes use of a cell phone and Bluetooth technology [9] . Bluetooth technology is secured and low cost. It makes use of an Arduino Bluetooth board. An interactive python program is used in the cell phone to provide the user interface. The I/O ports of the Bluetooth board and relays are used for interfacing with the devices which are to be controlled. The Bluetooth is password protected to ensure that the system is secure and not misused by any intruders. The Bluetooth has a range of 10 to 100 meters, 2.4 GHz bandwidth and 3Mbps speed. The python app on the phone is portable. It is also a fast and cost effective system. There is a diagnostic system that can detect problems in the circuitry. A feedback system will report status of devices after every signal toggle. The main drawback with respect to Bluetooth is that it takes a long time to discover and access devices in its vicinity. It does not provide energy conservation tips. Real time access cannot be achieved. Anywhere access to the devices cannot be achieved. Access is limited to within the Bluetooth range.



2 Block Diagram of Home Automation

### 2.3 Phone Based Home Automation

Some systems [11] are described as an enabling system that can be used to provide a common framework for home Automation. It provides a system for a smart home that includes facilities such as a system controller, housewide wiring and a common interface. This will enable using the existing system for home automation. A hardware based remote controller for power point control has been described [12]. The function of this remote controller is to control the power supplied to devices at a remote location. The system uses the telephone line for transmitting the commands. The controller is a logic system built entirely of hardware. It eliminates the cost incurred with microcontrollers. It uses a DTMF transceiver which is interfaced with a solid state relay to control the power supply. It could also be implemented experimentally with infra red signals and AC power line carrier technology.

A home automation system makes use of the dual tone multi frequency (DTMF) used in telephone lines [13]. The system as shown in figure 3 uses the standard public-switched telephone lines. There are three components in the system. The first is the DTMF receiver and ring detector. The second part is the IO interface unit. The third part is the PC which does the online operations. The PC detects the ringing of the line and then authenticates the user. After this the user will be allowed to use the keypad tones to control the devices as required. An example of stepper motor control is taken up. This system has the advantage of being secure and allowing international standardization. This is because the DTMF tones are the same all over the world. But it suffers from the drawback that the number of appliances is limited by the number of keys in the keypad. An ordinary phone usually has 12 keys only.

### 2.4 ZigBee Based Home Automation

The ZigBee wireless communication technology can be applied [14] for home automation. The system uses PIC microcontroller and voice recognition for this purpose. The voice commands are taken from a mike. They are compared with a voice store and processed. The PIC microcontroller then transmits the commands through ZigBee to the receiver. The receiver unit has another PIC microcontroller that can process the command. It uses relays to control the respective appliances. This system has the drawback that ZigBee is a low range communication medium. So remote access is hindered from faraway locations. Also, the voice recognition module could become unwieldy. This system has the added feature of integrating a smoke detector to the system. When smoke is sensed, it sends a message to the user's built-in mobile number.



## 2.5 Wireless Control Systems

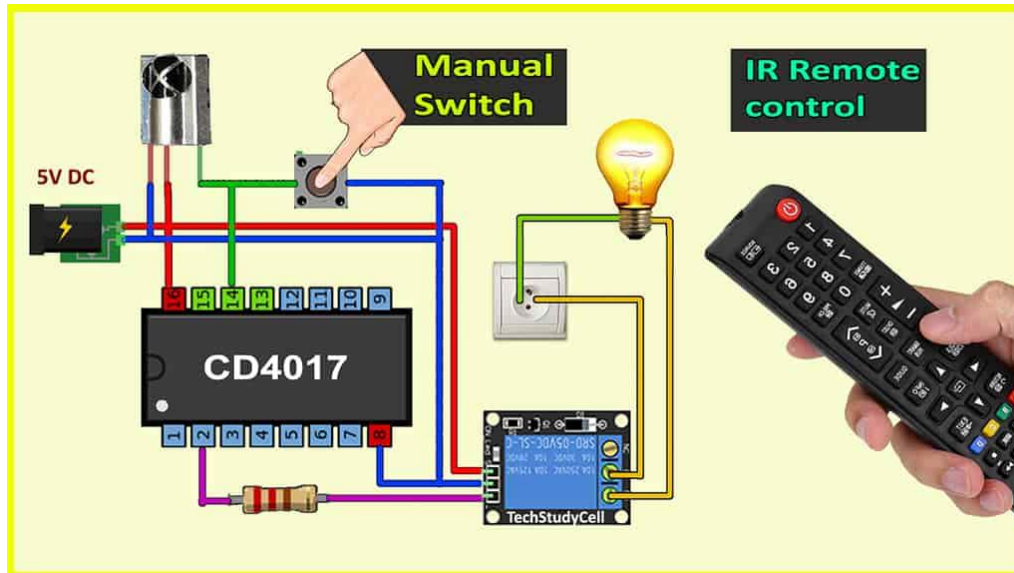
Systems using wireless communication can be made [15] by linking up stand alone appliances that are present at home or in office and integrating to form a co operating network. A combination of various technologies like Wi-Fi and Bluetooth are used to integrate the system. Such a system is laid out as illustrated in figure 5 & 6. The universal Plug and play capability is used to provide a transparent network of devices to the user. The system makes use of the Open Service Gateway Interface (OSGi). The appliances are connected via different networking technologies. The user application layer makes use of web browsers, pocket PC application and a central console. Speech based commands can also be used for controlling the appliances. Advanced features are provided such as device discovery and device connection. The entire system is implemented in a Linux platform. The system also has the ability to add intelligent control modules. These control modules are capable of knowledge capturing and pattern recognition. The universal plug and play system uses many standard protocols for interoperability. The main advantage of the system is its interoperability. Another advantage is the dynamic discovery of the service. It also has the ability for sharing of service.

The system proposed uses an Arduino board along with Wi-Fi communication technology [16] . It also has the option of another automated mode where there are temperature and light sensors which can be set to control the appliances depending on the conditions. The system uses an Android smart phone to communicate with a home PC those servers as a server. The PC is connected to and controls the Arduino board. The GUI is designed using MATLAB. The mobile phone can communicate with the PC through Internet. Internet access is through Wi-Fi. However, this extension is not implemented in the system. The system has the advantage of remote access through the phone. The drawback is that the PC needs to be left on all the time. Also it depends on Wi-Fi for internet access which is not reliable and not widely available

## 2.6 Mixed Type Home automation is achieved

with a combination of GSM, Bluetooth and ZigBee technologies. The user interfacing is done through an Android application. This application takes user voice input and maps it to a set of textual commands. These commands are sent through SMS to another phone at home. This in turn transfers the commands through Bluetooth to a PIC controller. This is called a remote unit. This remote unit will then send the commands to a ZigBee transceiver. This transfers these commands through ZigBee to the main controller. The controller interprets the commands and performs the required operations. It also sends back status information through ZigBee. This system is usable and can offer remote access. However, the system can become expensive due the use of multiple controllers and technologies. Also, the SMS system can prove to be unreliable. A study of the various technologies that can be applied to home automation is done [18] .

Specifically, it talks about how modern day networking protocols can be applied to enable home automation. It proposes that standardization of home automation technologies can be achieved using Internet Protocol (IP). The UPnP is an extension of the plug and play capabilities. The paper recommends use of GSM networks as a backup facility, while a web based application can be the primary user interface. Technologies like Wi-Fi and X-10 protocols can be used to ensure connectivity with the home



#### IV. CONCLUSION

Based on all the systems surveyed and their advantages and drawbacks, this paper presents the features to be possessed by an ideal system for home automation with remote access. An ideal system should be available from all over the world to a user and in real time. A GSM network is identified as a candidate for this. However, the data channel of GSM must be used, to provide internet access. Only the Internet can ensure that access can be made available at all times. This will give rise to a standard access method for the home appliances using the Internet protocol. The user interface should be a web application that has an associated mobile application. So that people of all kinds can access the system. Such a system should also have the feature of being easy to install. Only then can automated homes become commercially viable. There should be a lot of thought put into the design of the user interface for these apps. Plug and play capabilities will be an added bonus for the system. Ease of adding a new device to an automated house will play an important role in taking forward the systems commercially.

Future scope for the home automation systems involves making homes even smarter. Homes can be interfaced with sensors including motion sensors, light sensors and temperature sensors and provide automated toggling of devices based on conditions. More energy can be conserved by ensuring occupation of the house before turning on devices and checking brightness and turning off lights if not necessary. The system can be integrated closely with home security solutions to allow greater control and safety for home owners. The next step would be to extend this system to automate a large scale environment, such as offices and factories.

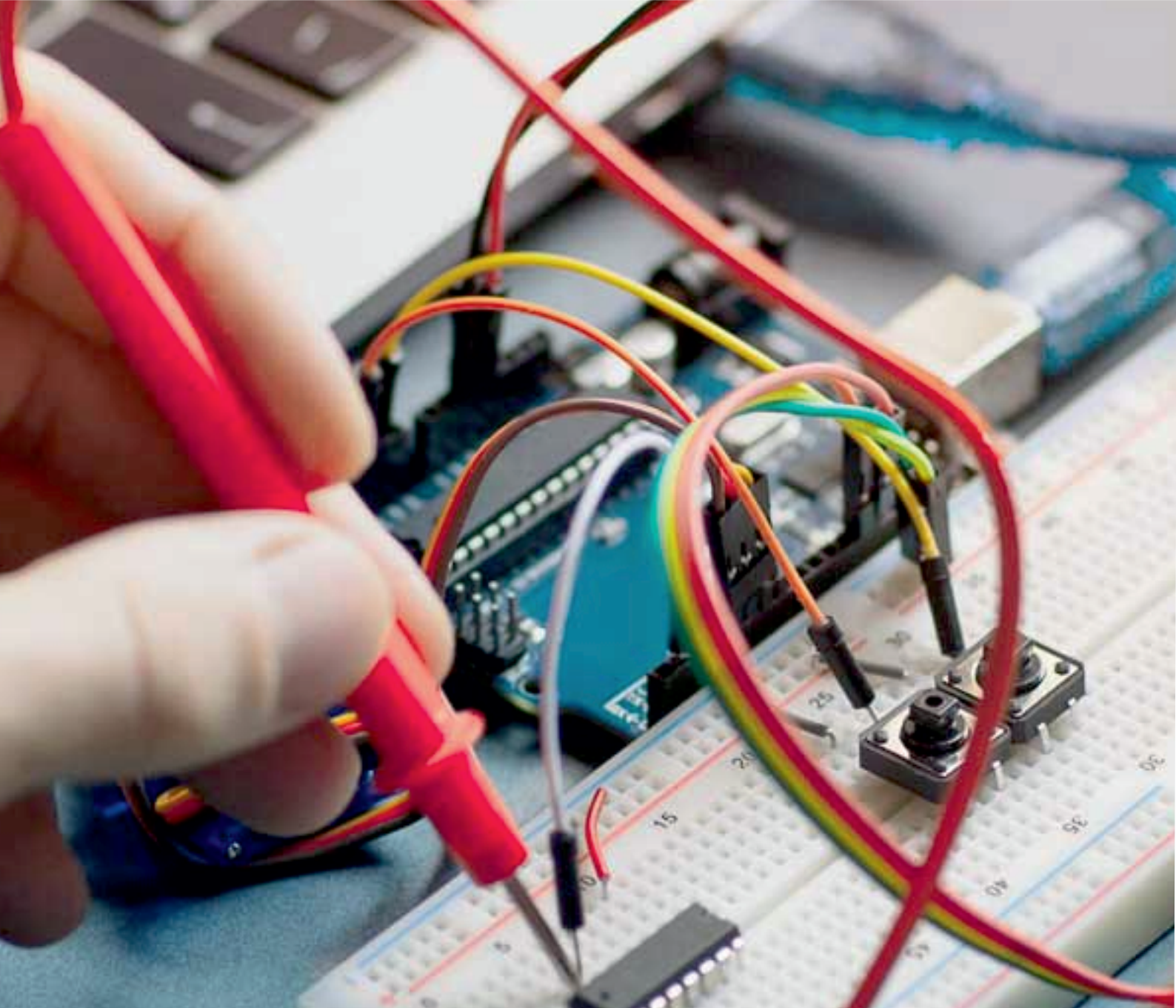
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