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# Design and Assembly of Juice Mixer

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**ABSTRACT:** The refreshments industry is currently at a stalemate where most consumers are oriented towards typical, rigid and low- quality juice products. Most if not all vending machines are of low quality, as most of them offer products that include high amounts of preservative substances due to the machine's inability to maintain fresh products. Moreover, most if not all of the vending machines available in today's market suffer from poorly maintained exterior frames and internal components, in addition to limited functionalities. The design of an automated juice mixing machine that provides the user with a convenient access to healthy alternatives is proposed. The machine can be used at homes and restaurants. A detailed description of the mechanical assembly as well as testing and verification of the correct functionality of the components used are provided. The proposed juice mixing machine has four aluminium containers holding four different types of juices, each having a capacity of 1500 ml. The fifth container holds the water that is used to clean the blender after each cycle. After depositing the payment (in case of using the machine at restaurants), the user can select the desired juice mix using a thin-film transistor (TFT) touchscreen. The TFT screen displays four selections to be chosen by the user. Furthermore, the user can specify the percentage for each type of juice in the mix. After specifying the percentage of each type of juice, the user is then instructed to choose one of the available two cup sizes. The microcontroller completes the required computations of different juice percentages based on the user's choice and cup size. Tubing connections and pumps transfer the require amount of different juices from the containers into the blender, which will perform flavour fusion. All electrical and mechanical components were tested separately to verify correct functionality before final assembly. The microcontroller used is the Arduino Mega which has sufficient number of input and output pins. The controller orchestrates the operation of all components used. Experimental results after final assembly of the machine confirm its correct functionality.

**KEYWORDS**: Automation, Juice Mixer, Microcontroller, TFT Screen, Valve, Blender, Peltier Thermoelectric Cooler, Pump.

## I. INTRODUCTION

The 2016 annual meeting of World Economic Forum (WEF), stated that the global economy is on the edge of extreme changes that are comparable in magnitude to the first Industrial Revolution. The WEF has singled out one integral technology that was marked as extreme automation. Automation involves the use of various control systems in order to operate equipment with minimal or reduced human intervention. Modern automation systems consist of electrical and mechanical components managed through digital controllers. In the last three years, many Software-Based Intelligent Process Automation products have been introduced in the market. A guide has been developed with the intention to establish a consistent reference for an objective set of criteria to evaluate the capabilities of products in the Intelligent Process Automation family. Today, there is an increasing demand and technology push to reduce human supervision through the use of automated systems. This transition is aimed mainly to improve productivity and increase efficiency. Home automation is now considered as a soaring industry in many of the developing nations. Tremendous drivein business sector has led to hardware partnerships towards home automation. Sony and Apple organizations are attempting to claim a business portion based on home automation. The current impact of Automation based on sensing technologies, artificial intelligence, and networked infrastructure is greatly uncertain. In, the relationship between accuracy and controllability is investigated in 750 participants using a controlled gamified task. Self-reported satisfaction remained constant with high controllability, even under very low accuracy conditions. A strong preference was detected for using manual control rather than automated, despite much slower performance and very poor controllability. Automation systems have been an area for trained experts in highly specialized tasks, until recently where more non-expert users encounter automated systems in their everyday life. The deployment of automated systems has changed practices and experiences in various fields. Human-Automation Interaction (HAI) research, has increased our understanding of how humans are influenced by automation. Research in Human Computer Interaction (HCI) that investigates the relation of automation and user experience is rare.

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## II. MOTIVATION AND PROBLEM STATEMENT

Proposed algorithm The automated and mechanized food industry is mostly based on mainstream brand distribution where most vending machines rely on brand market popularity, like sodas, snacks, and coffee vending machines. Moreover, most if not all of the vending machines available in today's market suffer from poorly maintained exterior frames and internal components, in addition to limited functionalities. Unfortunately, automated machines for the distribution of high-quality natural beverages fall short in this industry. This paper introduces the design of an automated juice mixing machine that provides the user with a convenient access to healthy alternatives. The proposed machine can be equally used at homes and restaurants. The proposed automated juice mixing machine is made out of several components that include a microcontroller, liquid flow meter, Peltier thermoelectric cooler, water pump, temperature sensor, a mixer, and a touch screen. The proposed machine allows the user to pick between two cup sizes, small and large. Furthermore, the user can choose to drink one type of juice or have a mix of two, three, or four different types of natural juices. The mixer is automatically cleaned after every use.

## III. LITERATURE REVIEW

The authors in discuss the design and implementation of a juice mixer machine. The proposed machine contains the following basic components: the Arduino Mega2560, HX711weight sensor module with load cell, five 12V DC water gear pump motor, relay modules, 20x4 LCD and 4x5 matrix keypad. This proposed machine has five channels with five different juice tanks, which are connected to water gear pump motors which hare controlled by relays. The user can select the desired juice from a keypad. The desired percentage of each juice is calculated by using the weight sensor module. Drink-O-Mender is a social robot which serves different fruit juices and iced tea. The proposed robot can monitor the user's selected beverage and its quantity using a smart scale. This information is used with the aim of supporting the user's healthy nutrition. The proposed interactive design includes a Reeti robot augmented with additional sensing and adaptation abilities. The robot which is designed to offer drinks in a social setting, aims to persuade users of consuming healthy drinks. An interactive system for influencing the level of user satisfaction experienced when drinking a beverage is presented. The proposed system controls the user's beverage consumption by creating a volume perception illusion using augmented reality that changes the apparent size of the cup. Results show that the consumption of beverages is influenced by the shape of the beverage container. Users consumed greater amounts when drinking from a visually lengthened cup and consumed smaller amounts when drinking from a visually shortened cup. Hence, the proposed technique can be used for daily health-care applications with wearable computers Water Coaster is a mobile application and device used to motivate people to drink beverages more often and more regularly. The Water Coaster measures the amount drunk by the user and reminds him/her to consume more, if necessary. The app is designed as a game in which the user needs to take care of a virtual character living in a fish tank, where the water level is dropped if the user does not consume beverages in a healthy way. In, Virtual Cocktail (Voctail); an interactive drinking utensil that digitally simulates multisensory flavor experiences is introduced. Three sensory modalities, taste, smell, and color are utilized by Voctail in order to create virtual flavors and augment the existing flavors of a beverage. The system consists of a mobile application that enables users to create customized virtual flavor sensations by configuring each of the stimuli via Blue-tooth. The system includes a cocktail glass that is fused into a 3D printed structure, which holds the electronic control module, three scent cartridges, and three micro air-pumps. When a user drinks from the system, the color is controlled by the RGB light projected on the beverage, the taste is controlled by the electrical stimulation at the tip of the tongue, and the smell is controlled by the micro air-pumps to are combined to create a virtual flavor sensation. In, Virtual Cocktail (Voctail); an interactive drinking utensil that digitally simulates multisensory flavor experiences is introduced. Three sensory modalities, taste, smell, and color are utilized by Voctail in order to create virtual flavors and augment the existing flavors of a beverage. The system consists of a mobile application that enables users to create customized virtual flavor sensations by configuring each of the stimuli via Blue-tooth. The system includes a cocktail glass that is fused into a 3D printed structure, which holds the electronic control module, three scent cartridges, and three micro air-pumps. When a user drinks from the system, the color is controlled by the RGB light projected on the beverage, the taste is controlled by the electrical stimulation at the tip of the tongue, and the smell is controlled by the micro air-pumps to are combined to create a virtual flavor sensation.

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The authors in have conducted a real-world study of a water serving robot at a university cafeteria. The robot was operated in a Wizard-of-Oz manner where it offered water to students having their lunch. The analysis results of the relationship between robot gaze direction and the likelihood that someone takes a drink show that if people do not already have a drink and the interaction is not dominated by an overly enthusiastic user, the robot's gaze behavior is effective in selecting an interaction partner. The design of a fast food vending machine where the user can choose the type and quantity of hamburgers and drinks on the touchscreen or mobile phone is proposed. The selected food items are delivered to the dining window via a conveyor. The chef can remotely monitor the stock of hamburgers and drinks through a mobile phone or a computer.

## IV. DESIGN AND ANALYSIS

In this section, different systems aspects involved in the design of the proposed automated juice mixing machine are explained.

### System Architecture and Flowchart

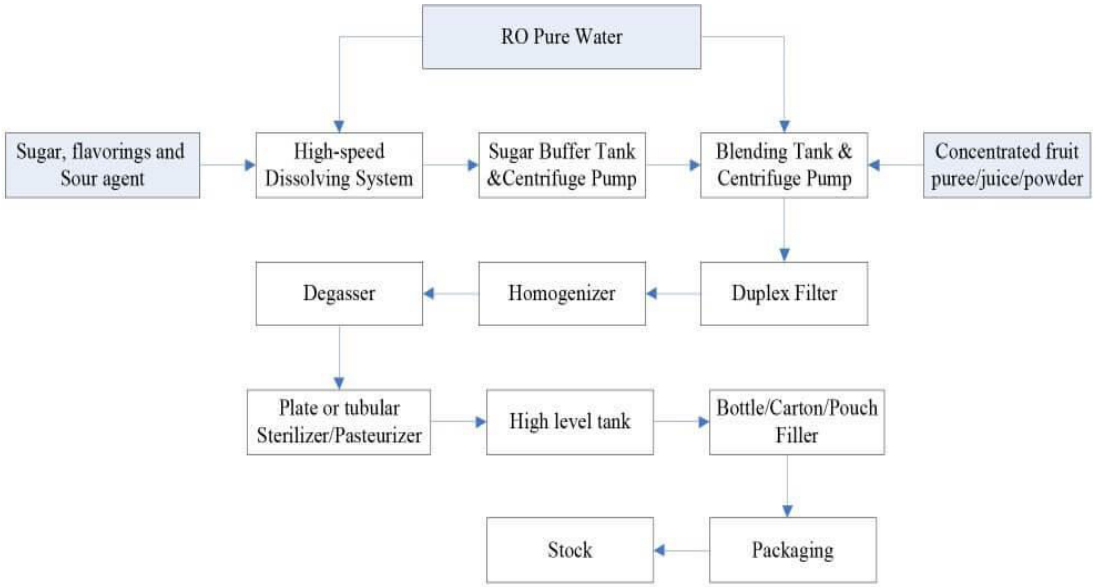


Figure 1. Juice mixing machine flowchart

The system architecture demonstrates all the components used in building the automated juice mixing machine and the relation between them. For simplicity, the system architecture has been divided to two figures, the first figure is for the inputs and the second one is for the outputs as shown in figures 1 and 2, respectively. Figure 3 presents the flowchart of the proposed machine. This flowchart explains the nature of operation for a single cycle of interaction between the user and the machine. At the start, the machine needs to be connected to a power supply and turned on. When it is activated, the cooling system is switched on and the machine will be on hold and waiting for a payment from the user. When the payment is deposited, the user can use the thin-film transistor (TFT) touchscreen to select the type of desired juice based on his/her preference. The TFT screen displays four selections, one of which to be chosen by the user. The four selections are the following: one type of juice, a mix of two types, three types, and four types of juice. Furthermore, for the second to the fourth selection, the user can specify the percentage for each type of juice in the mix. After specifying the percentage of each type of juice, the user is then instructed to choose one of the available two cup sizes. The microcontroller completes the required computations of different juice percentages based on the user's choice and cup size. The pump associated with each type of juice will then be activated. The different types of juices will flow to the mixer which is activated to mix all juices together.

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After that, the mixer pump will turn on and the mixed juice is poured into the cup. The flow meter measures the liquid rate of motion through a pipe using a magnetic field to compute the volumetric flow. Magnetic flow meters are based on the principle of Faraday's law of electromagnetic induction, according to which liquid generates voltage when it flows through a magnetic field. The liquid flow sensor is required to record and report the compressed and pumped amount of juice into the cup. In order to reach required amounts, several tests were performed. The microcontroller used is the Arduino Mega. It has 54 digital I/O pins and 16 analog I/O pins. It is equipped with a 256kB of flash memory, 8kB SRAM, and 4kB of EEPROM. The clock frequency of the chip is 16 MHz. The working voltage on the chip is recommended to be in the range of 7 to 12 V.

## V. IMPLEMENTATION AND ASSEMBLY

The rectangular wooden frame of the proposed juice mixing machine has a thickness of 5 mm. Four containers are used for the four different types of juices, each having a capacity of 1500 ml and is made of aluminum. The fifth container holds the water that is used to clean the blender after each cycle. The blender used also has the same capacity of 1500 ml. The inner section of the frame showing the coolers and bender is shown in Figure 4. Figure 5 demonstrates how the blender cup was drilled to make a hole as an exit for the mixed juice. A plastic valve with a pump is used to connect the blender cup with a tube. Five round holes were drilled in the lid of the blender cup and are connected to the tubes (Figures 6 and 7). Four of the holes are for the four types of juice and one hole is for the water used to clean up the blender after each cycle. The next step was the placement of the top side of the frame. The cup is placed on the blender base and is covered by the blender lid with the five tubes connected as shown in Figure 8. Each pump is then placed inside one of the five containers which are rested on top of the frame as presented in figures 9 and 10, respectively.

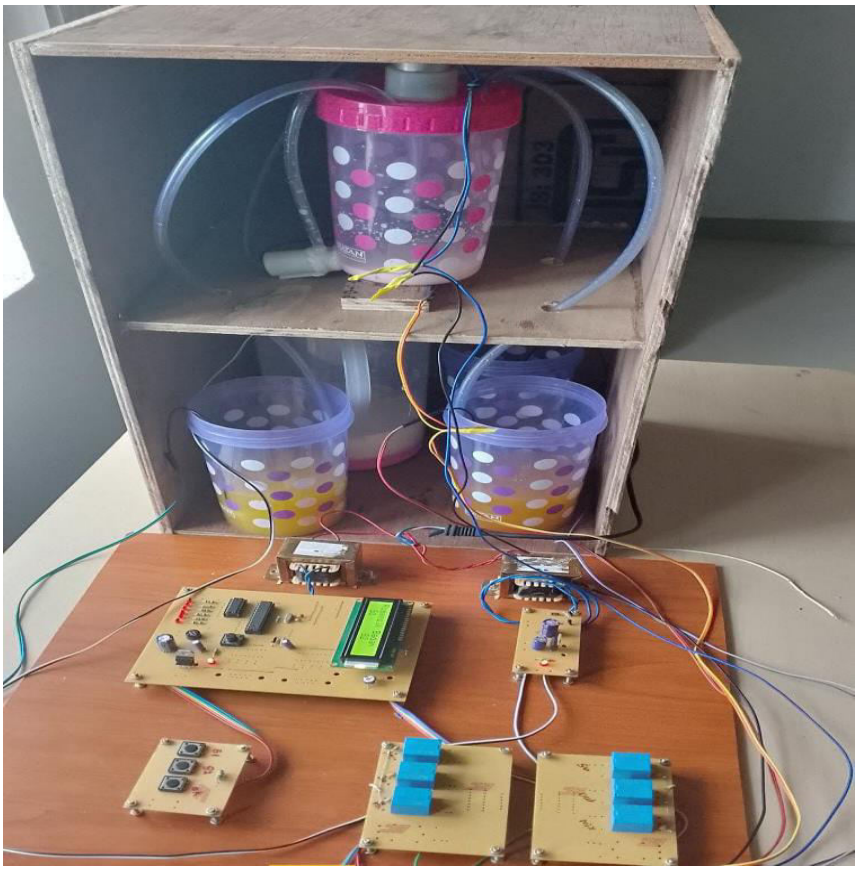

Figure 2. Juice mixer

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### V. 1. RELAY

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals.

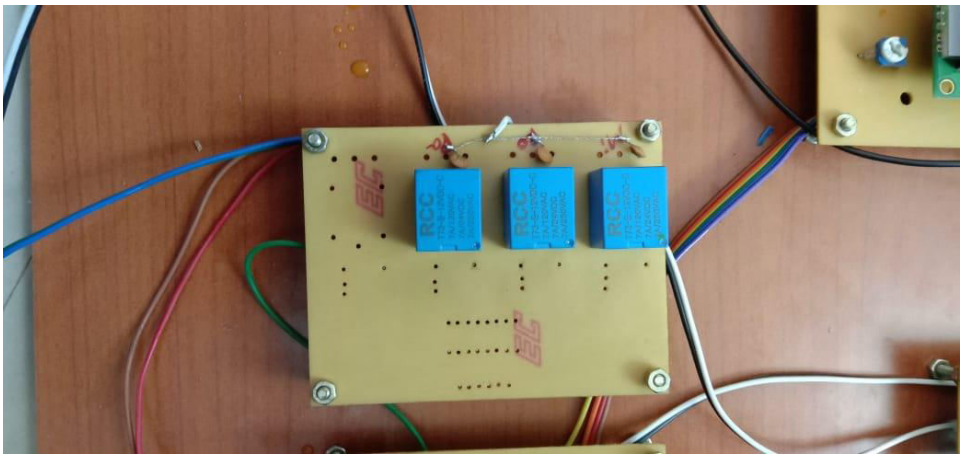

Figure 3. Relay

### V .2. LCD

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

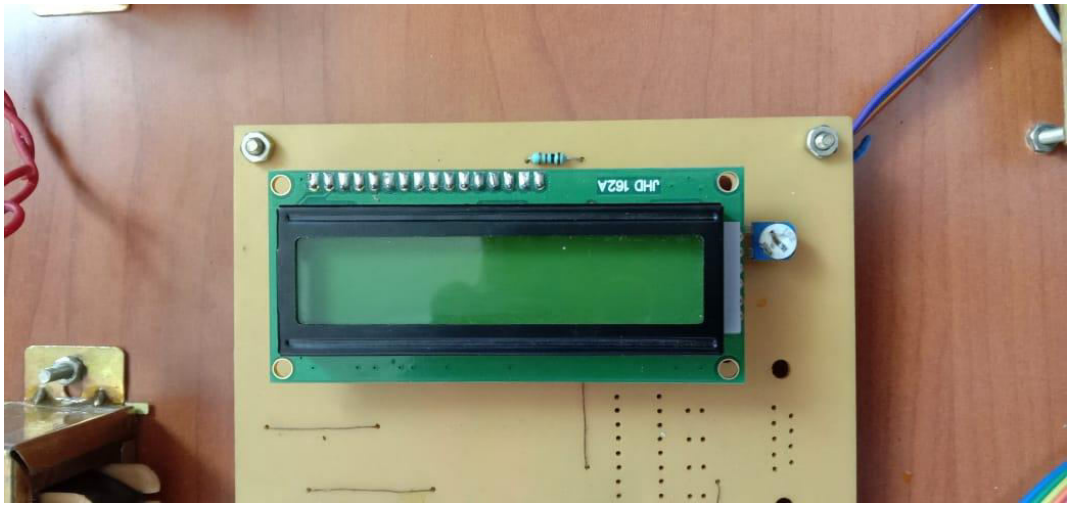

Figure 4. LCD

### V. 3. DC MOTOR WITH PUMP

A DC motor is any of a class of rotary electrical motors that converts Direct Current (DC) electrical energy into mechanical energy. DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways.

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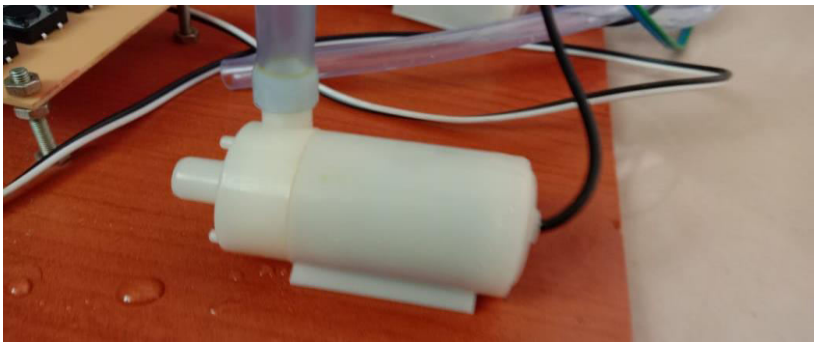

Figure 5. Dc motor with pump

## V. 4. POWER SUPPLY

A power supply is an electrical device that supplies electric power to an electrical load. The main purpose of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

Figure 6. Power supply

## V. 5. STEP DOWN TRANSFORMER

A step-down transformer is an electrical device that reduces the voltage of an alternating current (AC) power supply. It consists of a primary winding, a secondary winding, and an iron core. When an AC voltage is applied to the primary winding, it creates a fluctuating magnetic field in the iron core.

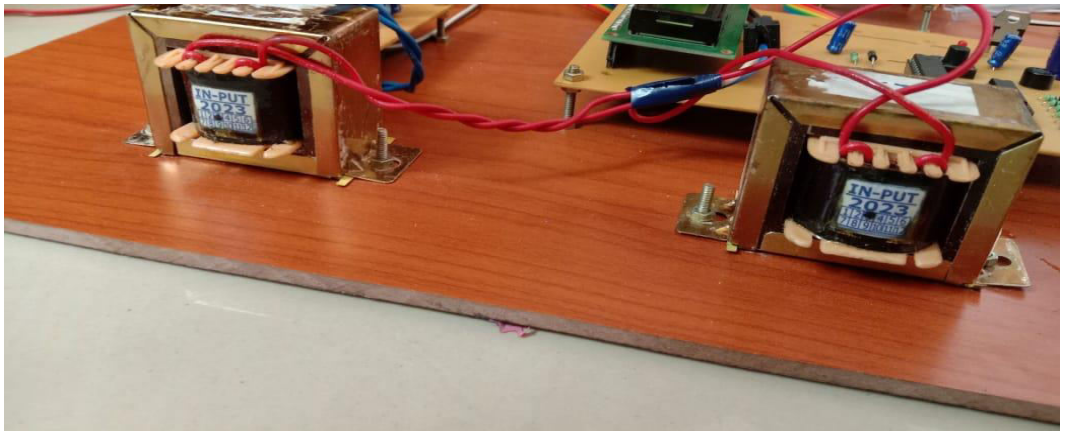


Figure 7. Step down transformer

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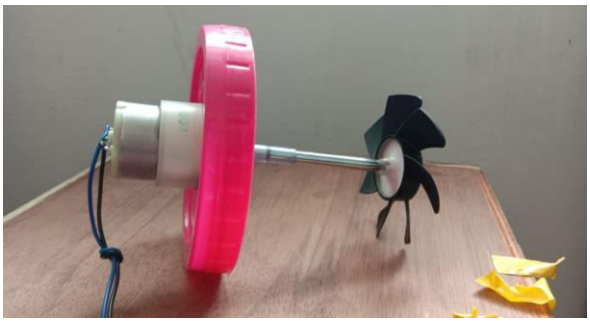

Figure 8. Mixer

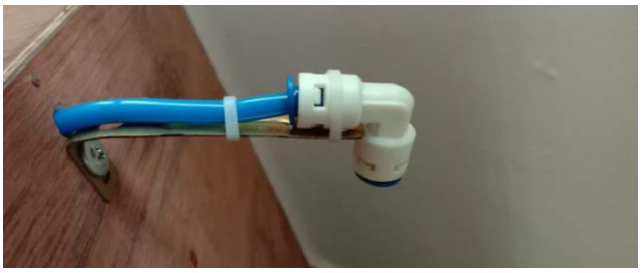

Figure 9. Pipe

## VI. CONCLUSION

In this paper, the design, programming, and assembly of an automated juice mixing machine has been introduced. The main goal of the proposed machine is to provide a fast and convenient access to healthy juices at homes and restaurants. Different components of the machine have been testing individually to ensure correct functionality before final assembly and implementation. Future plan includes but is not limited to the following: adding a level sensor to alarm the user when one of the juice containers is running low and needs to be refilled, developing an app to connect the machine to the local network so that the user can order and prepare the desired mix remotely, adding a temperature sensor to keep track of the functionality of the coolers, and a mechanism to get rid of the juice if the cooler malfunctions for some reason.

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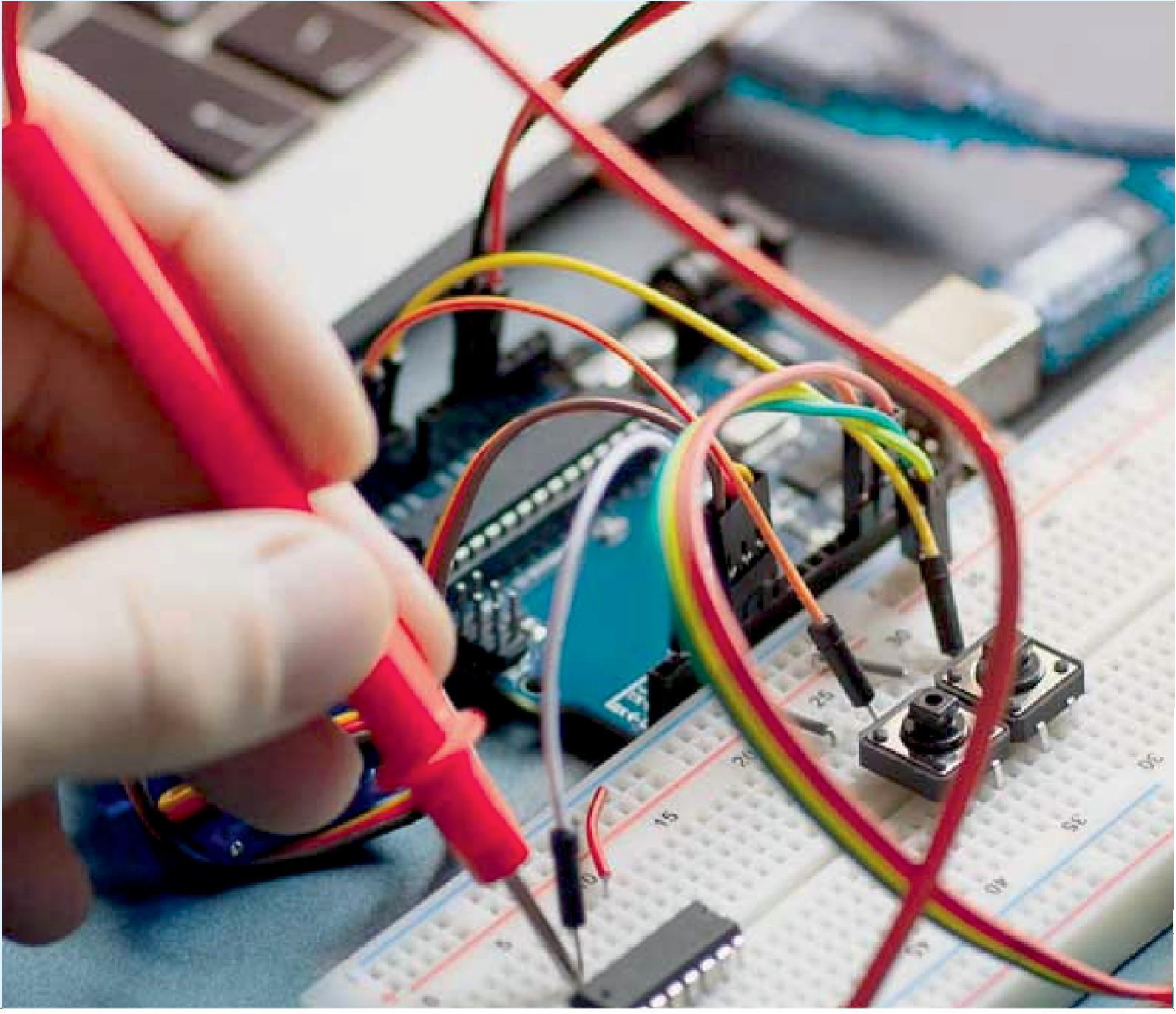

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