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Design and Development of Smart Cart

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ABSTRACT—

In this paper, we present a solution to the billing time issues that shopping malls encounter. We also present a very advanced system that works well for COVID-19 and is a good method for social isolation. The technology suggested is the Smart Trolley because when the products are put in it gets scanned and purchased item and its amount shown concurrently on LCD automatically. This solves the unique difficulty for consumers, especially in billing. It makes use of RFID technology, which can scan a large number of things and help save both consumers' and the mall's valuable time.

I. INTRODUCTION

Today, there are more retail centres than ever before. Customers occasionally complain about insufficient product information and wasted time at the check-out stations. Shopping centres are now implementing barcode standards. Although it has replaced the prior manual procedure, this technology has several drawbacks. While RFID may be tracked automatically, barcode scanners require manual tracking. Barcodes also need a significant amount of labour and human effort. Barcodes are easily cracked. In addition to this, the Barcode method requires customers to wait in queue at the square while having their products scanned and invoices prepared. Even with all of those drawbacks, the barcode technology is still in use. There is clearly a desire to implement better and more cost-effective methods. The development of modern methods, such as RFID technology and wireless networks, has sped up the shopping process and increased its efficiency and transparency.

II. METHODOLOGY

The system's initial power source is a DC supply, and a 12V DC source powers the complete system while it is in use. On the system, the 12v is segregated into various modules. such as the motion, billing, and power supply modules. Following the functioning of motors connected by infrared sensors that detect motion in the forward, left, and right directions, electricity is given to the power supply module. The engines are even connected to the EM relay. Arduino UNO is the system's brains. The information about the item is presented on the LCD 16X2 once it has been scanned using an RFID scanner. The Arduino UNO has the programme loaded. The buzzer buzzes to signal when the object has been scanned. Additionally, the consumer must scan the QR code on the cart in order to pay the bill.

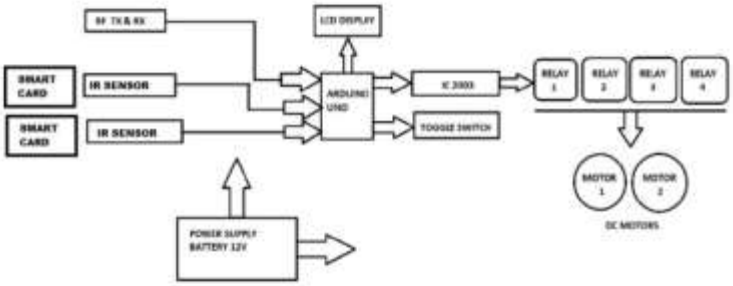

Fig.1 Block diagram of operation of SMART CART

III. COMPONENTS

Arduino UNO in a

Microcontroller: ATmega328; Operating Voltage: 5V; Recommended Input Voltage: 7 to 12V; Limiting Input Voltage: 6 to 20V; Digital I/O Pins: 14 (of which 6 give PWM output);

• Six analogue input pins

Flash Memory: 32 KB, of which 0.5 KB is used by the bootloader; SRAM: 2 KB; EEPROM: 1 KB; Clock Speed: 16 MHz; DC Current per I/O Pin: 40 mA; DC Current per 3.3V Pin: 50 mA; Flash Memory: 32 KB, of which 0.5 KB is used by the bootloader; SRAM: 2 KB; EEPROM: 1 KB; Clock Speed: 16 MHz 23 programmable input/output (I/O) pins, including six PWM pins and six analogue input pins, are available on the ATmega328P. A number of sensors, actuators, and other external devices can interface with these pins. The microcontroller may also communicate with other devices including sensors, displays, and wireless modules thanks to support for serial communication protocols like UART, SPI, and I2C.

The ATmega328P is widely used in Arduino boards due to its low cost, simplicity of usage, and accessibility to a sizable user and development community. Both novice and expert users may easily programme the ATmega328P and communicate with other devices using the Arduino IDE (Integrated Development Environment), which offers a straightforward and user-friendly interface.

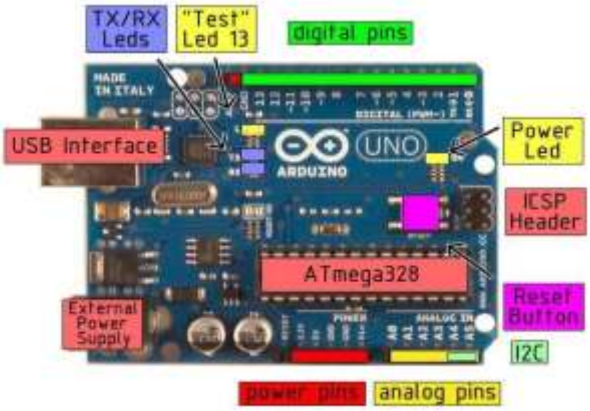

Fig. 2 Arduino Uno

B. RF TRANS-RECEIVER MODULE

The Radio Frequency transmitter and receiver devices that are utilised in this system to broadcast the code signal are explained in this module.

→ RF TRANSMITTER MODULE

An RF transmitter module can also be used by a Smart Cart to enable wireless connection with external devices, such a central server or RFID sensors. The Smart Cart, for instance, may be equipped with a 433 MHz frequency-band RF transmitter module, enabling it to broadcast information to RFID sensors placed throughout the store.

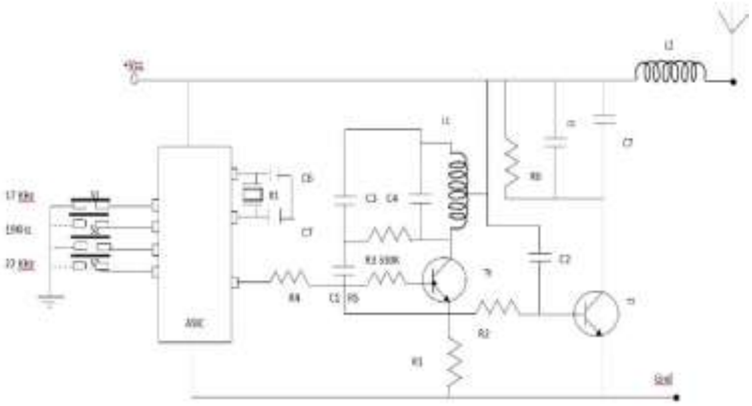

Fig.3 Circuit diagram of RF Transmitter

→ RF RECEIVER

Radio signals emitted by other devices are received by an RF (Radio Frequency) receiver. The architecture of the receiver and the transmission protocol in use dictate the frequencies at which the receiver is intended to receive signals. A radio signal is amplified by the RF receiver when it is received to increase its strength. The improved signal is then filtered to remove any extraneous interference or noise. Following that, the signal is demodulated, or converted from a radio frequency signal to a lower frequency signal that the receiver's circuits can understand. The signal is then demodulated by a microcontroller or another processing device to yield the necessary data, audio, or video. The obtained information is often displayed on a screen or used to control other devices.

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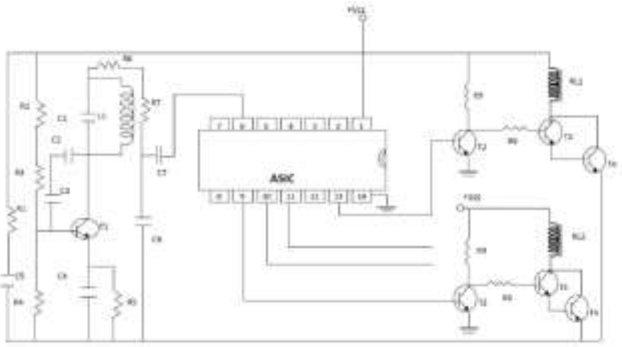

Fig.4 Circuit diagram of RF Receiver

C. IR TRANS-RECEIVER MODULE.

An IR (Infrared) Trans-Receiver Module is an element of electronic equipment that can send and receive infrared signals. These modules are made up of an IR LED (Infrared Light Emitting Diode) and an IR photodiode packed in a single package

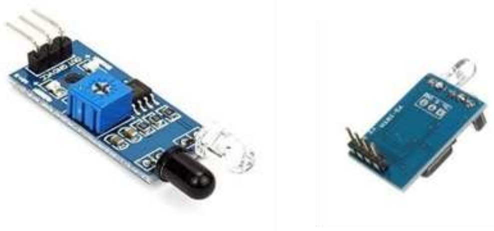

Fig.5 IR sensor

→ IR TRANSMITTER

An infrared photodiode serves as the receiver and an infrared LED serves as the transmitter. The infrared light that an infrared LED emits triggers the infrared photodiode. The amount of acquired infrared light is proportional to the photodiode's resistance and the change in output voltage.

• A forward voltage of around 2V

• A 10 to 20 mA forward operation current.

• The IR LED's maximum reverse voltage tolerance ranges from 3 to 5V. →

IR RECEIVER:

The signal input, supply pin, and ground pin are the three terminals of the IR Sensor Module. This module operates on regulated +5Votls, and going above this limit might result in harm. Therefore, a biassing resistor R1 provides Vcc to this sensor, and a grounded pin is connected to the supply's negative end. Anytime infrared light strikes the sensor's eye—the black mole on the sensor—variable signal voltages are produced at the output pin. Through a current-limiting resistor R2, this is sent to the amplifier stage created by the PNP transistor TR1. This amplifier's output is routed through IC2 to a buffer there. The signal's current carrying capacity is increased and sent to the driving stage by this buffer or converter. The signal output is monitored by observing the glowing indicator LED D4.

→ DRIVER & CIRCUIT BREAKER:

A low-impedance relay and TR1 serve as the foundation of the driver. The signal diode D3 is there to stop the back E.M.F that is created by the relay switching operation. There are no signals sent to the TR2 base when the user doesn't press any keys since the receiver isn't picking up any IR rays from the other end.

This E-Power Supply unit's receiver warns the driving section when it detects an interruption of IR Rays from the opposing IR Transmitter. The relay RL1 is activated when the IR signal from the buffer enters the base of TR2, travels through saturation, and so on. Considering that the Schmitt Trigger Circuit is linked to the N/O [Normally Open] pins of Relay RL1.

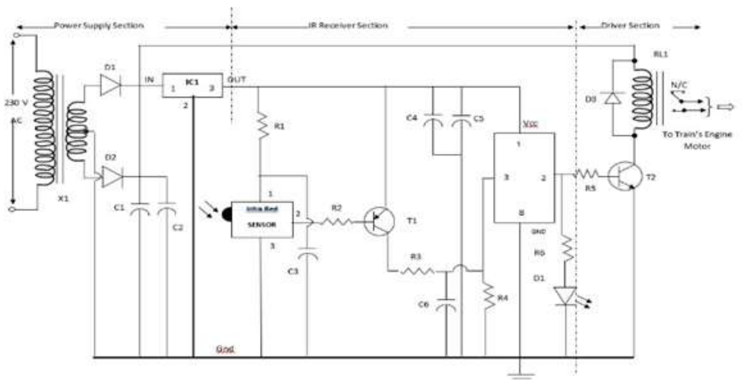

Fig.6 circuit diagram of IR receiver, driver & circuit breaker

1) LCD

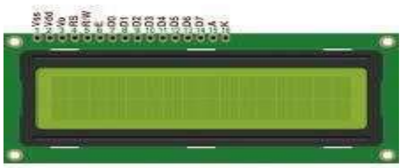

Fig.6 LCD (16x2)

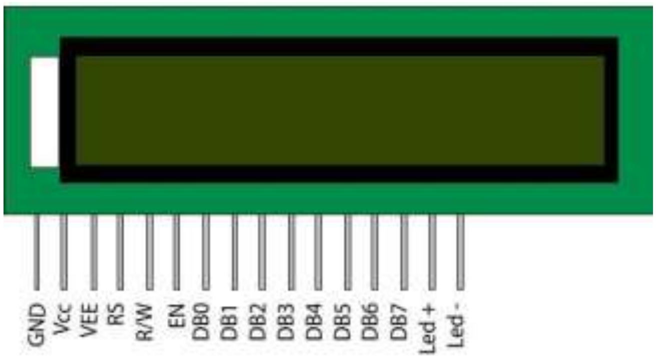

Fig.7 PIN Diagram

In a Smart Cart, an LCD (Liquid Crystal Display) can be utilised to convey visual information to the user or store workers.The LCD can show a variety of information, such as product information, promotional offers, or the status of the Smart Cart.

Select an LCD module based on the size and resolution needed for the Smart Cart's display.
Character displays with 16x2 or 20x4 resolutions are common, as are graphical displays with higher resolutions. Connect the LCD module to the Atmega 328P microcontroller using the connector and specs provided by the module. Connecting data and control lines to the proper pins on the microcontroller is typical. To control the LCD module, write code in the Atmega 328P programming language The parameters of the display, such as the number of rows and columns, should be defined in this code. It should also have functions for publishing text or graphical data to the display. Send the LCD module the required instructions to start it up. Typically, this involves giving the module a series of starting instructions, such as changing the number of rows and columns, turning on or off the display, and changing the cursor's position. A 16x2 LCD has two lines with a capacity for 16 characters each. On this LCD, each character is shown as a 5x7 pixel matrix. Command and Data registers are both present in this LCD.

The command instructions for the LCD are kept in the command register. An LCD receives a command when someone gives it instructions to carry out a certain operation, such as initialising it, cleaning its screen, placing the pointer, controlling the display, etc. The information that will be shown on the LCD is saved in the data register. The data is the ASCII value of the character that will be displayed on the LCD

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D.DC-MOTOR

In order to give Smart Carts movement or mobility, DC motors are frequently employed. An electromechanical device known as a DC motor transforms electrical energy into rotating mechanical energy. The rotor, stator, and commutator of a motor all function in concert to create motion.

E. RFID TAG

Fig. 8a: RFID CARD Fig.8b RFID Tags

The Smart Cart reads RFID (Radio-Frequency Identification) tags and communicates with them. The RFID reader on the Smart Cart can read data from RFID tags when they are in close proximity since they feature a tiny chip and antenna that may be attached to things. A Smart Cart can use RFID technology for a number of purposes, such as inventory management, tracking, and security. For instance, an RFID reader might be added to the Smart Cart, and the items inside the cart may be given tags.when items are added or removed from the inventory. This might increase the effectiveness and precision of inventory management. The Atmega 328P microcontroller may be used in a Smart Cart to implement RFID technology by coupling an RFID reader module to it. Radio-frequency signals may be used by the RFID reader module to connect with RFID tags and retrieve data from them. The microcontroller may utilise this information to run additional Smart Cart features like access control and inventory management. e fixed or portable. It uses radio waves to deliver impulses that turn on the tag. When activated, the tag returns a wave to the antenna, which transforms it into information. A Smart Cart can use RFID technology for a variety of purposes. To maintain inventory levels, track product movement, and deter theft, cart goods can be equipped with RFID tags. Additionally, they may be used to restrict access, giving permitted employees access to just certain areas of the cart or its contents.

Connect the RFID reader module via serial connection to the Atmega 328P microcontroller in order to implement RFID technology in a Smart Cart. The reader module may be powered by the microcontroller's 5V output, and the antenna can be attached to the module's antenna input.

F. TOGGLE SWITCH

Fig 9.Toggle switch

G. In a Smart Cart, a toggle switch may be used to control a variety of features or functionalities. Toggle switches have a lever that may be raised or lowered to turn on or off a circuit. A Smart Cart's toggle switch may be used to turn the cart on or off, change between operating modes, or activate or disable particular functions like lights or sensors.a different position. It will often lock into place in each position and stay there until pushed back. Actuators, or anything that switch a machine on or off, are toggle switches.

H. BUZZER AND LED

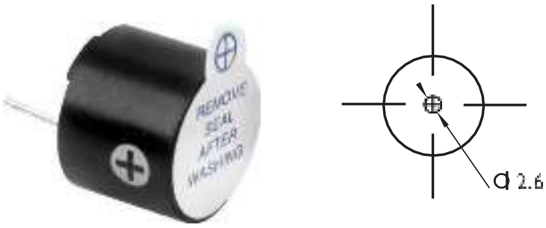

Fig.10 Buzzer and Sound port Specifications:

6V DC as the Rated Voltage

• 4 to 8V DC operating voltage

• 30mA Rated Current* Tone: Continuous; Sound Output at 10cm*: 85dB; Resonant Frequency: 2300–300Hz

• Weight: 2g • Millimetres Tolerance: 0.5mm • Operating Temperature: -25°C to +80°C • Storage Temperature: -30°C to +85°C

I. RFID Reader:

RFID tags or transponders may connect with RFID readers, which are electronic equipment. The reader emits an RF signal, which the RFID tag picks up and reacts to with a special identifying number. The computer or microcontroller may process the data and take actions based on the ID of the tag after receiving this number from the RFID reader. In a Smart Cart, an RFID reader may be used to interact with objects that have RFID tags attached to them as well as people who are accessing the cart's contents. The reader may be connected to the Smart Cart's microcontroller or computer system, enabling it to track product movement in real time, update inventory databases, and manage access to certain areas of the cart. In general, RFID technology may enhance the functionality and security of a Smart Cart, making it more effective and user-friendly.

Fig.11 RFID Reader

IV: CONSTRUCTION POWER SUPPLY MODULE: Receives a 12 volt DC source for the power supply module. The power supply module also has an LED with a limiting resistor, two integrated circuits (ICs) with the model numbers 7809 and 7805, two diodes IN4007, two filter capacitors with values of 1000 mF and 10 mF, and an LED.

SENSING MODULE/ MOTION MODULE:

Two IR sensors on the SENSING MODULE/MOTION MODULE are powered by 5 volts, and their outputs are supplied to the transistor BC557 through a limiting resistor connected to the transistor's collector. One at a time operation is what the BC557 asks the IC2003 motor driver to do. The electromagnetic relay in use has two coil points that are connected to a single motor.

SCANNING MODULE: An RFID reader with the model number EM18 is used to scan the goods in this module. The TX and RX pins of the Arduino UNO are connected. The RFID information from the products is given to the software. DISPLAY: The utilised pins are 7,8,9,10,11, and 12. Positive and negative examples are provided for comparison.

IV. WORKING

The entire circuit receives a 12v DC supply. Three different voltages are used: 5, 9, and 12 volts. The wheels are rotated in the appropriate direction by the IR sensors when they detect motion. such as: forward, right, and left. The merchandise with the RFID card attached can be scanned by the consumer. The product and total amount are shown on the LCD. To pay, the consumer must scan the QR code. Overall, this helps the buyer save time and yet enjoy the purchasing experience.

V. CODE

```
#include <Arduino.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
char input[12];
int count = 0;
int a;
int p1 = 0, p2 = 0, p3 = 0, p4 = 0;
int c1 = 0, c2 = 0, c3 = 0, c4 = 0;
double total = 0;
int count_prod = 0;
void setup ()
{
  pinMode(A4, INPUT_PULLUP);   pinMode(6, OUTPUT);   pinMode(7, OUTPUT);   pinMode(5, OUTPUT);
  lcd.init();   lcd.backlight();   lcd.clear();
  Wire.begin();   Serial.begin(9600);   lcd.setCursor(0, 0);   lcd.print(" AUTOMATIC BILL");
  delay (2000);   lcd.setCursor(0, 1);   lcd.print(" SHOPPING CART ");
  delay (2000);   lcd.clear();   lcd.setCursor(0, 0);
  lcd.print("Plz Add iTem");
} void loop() {   count = 0;
  while (Serial.available() && count < 12)
  {     input[count] = Serial.read();     count++;     delay(5);
  }
  int a = digitalRead(A4);
```

```
if ((strncmp(input, "xxxxxxxxxxxx", 12) == 0) && (a == 1))
{
lcd.setCursor(0, 0); lcd.print("Rice Added "); lcd.setCursor(0, 1); lcd.print("Price :- 10.00 "); p1++; digitalWrite(6, HIGH); digitalWrite(7, HIGH); digitalWrite(5, LOW); delay(2000); total = total + 10.00; count_prod++; digitalWrite(7, LOW); digitalWrite(6, LOW);
digitalWrite(5, HIGH);
}
else if ((strncmp(input, "xxxxxxxxxxxx", 12) == 0) && (a == 0))
{ if (p1 > 0)
{ lcd.clear(); lcd.setCursor(0, 0);
digitalWrite(6, LOW);
digitalWrite(7, LOW);
digitalWrite(5, HIGH);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Total Price :-");
lcd.setCursor(0, 1);
lcd.print(total);
}
else
{
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Not in cart!!! ");
digitalWrite(7, HIGH);
digitalWrite(6, HIGH);
digitalWrite(5, HIGH);
delay(2000);
digitalWrite(7, LOW);
digitalWrite(6, LOW);
digitalWrite(5, LOW);
lcd.clear();
}
}
if ((strncmp(input, "xxxxxxxxxxx", 12) == 0) && (a
== 1))
{
lcd.setCursor(0, 0);
lcd.print("Coffee Added ");
```

```
lcd.setCursor(0, 1);
lcd.print("Price :- 20.00 ");
p2++;
digitalWrite(7, HIGH);
digitalWrite(6, HIGH);
digitalWrite(5, LOW);
delay(2000);
total = total + 20.00;
count_prod++;
digitalWrite(7, LOW);
digitalWrite(6, LOW);
digitalWrite(5, HIGH);
}
else if ((strncmp(input, "xxxxxxxxxxx", 12) ==
0) && (a == 0))
{
if (p2 > 0)
{
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Coffee Removed!!! ");
digitalWrite(7, HIGH);
digitalWrite(6, HIGH);
digitalWrite(5, LOW);
delay(2000);
p2--;
```

```
total = total - 20.00;
count_prod--;
lcd.clear();
digitalWrite(7, LOW);
digitalWrite(6, LOW);
digitalWrite(5, HIGH);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Total Price :-");
lcd.setCursor(0, 1);
lcd.print(total);
}
else
{
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Not in cart!!! ");
digitalWrite(7, HIGH);
digitalWrite(6, HIGH);
digitalWrite(5, HIGH);
delay(2000);
digitalWrite(7, LOW);
digitalWrite(6, LOW);
digitalWrite(5, LOW);
lcd.clear();
}
}
if ((strncmp(input, "xxxxxxxxxxxx", 12) == 0) && (a
== 1))
{
lcd.setCursor(0, 0);
lcd.print("Oil Added ");
lcd.setCursor(0, 1);
lcd.print("Price :- 25.00 ");
p3++;
digitalWrite(7, HIGH);          digitalWrite(6, HIGH);
```

VII. EXPERIMENTAL VIEW

```
  digitalWrite(5, LOW);
 delay(2000);
  total = total + 25.00;
 count_prod++;
digitalWrite(7, LOW);
 digitalWrite(6, LOW);
  digitalWrite(5, HIGH);
 }
 else if ((strncmp(input, "xxxxxxxxxxx", 12) == 0) && (a == 0))
 {
   if (p3 > 0)
```

Fig. 12 Experimental setup of Smart Cart

```
{
 lcd.clear();
```

VIII. RESULT

The suggested model is user-friendly and simple to access.

It does not require specific training. The user will spend less time in the billing queue since there is less labour involved. The ability to service several users at once benefits both customers and businesses. This intelligent billing solution guarantees both time and financial efficiency.

• When the item is bought(scanned),after scanning product the product name and amount in displayed on LCD display.

Turn on the toggle switch and re-scan the product to be removed if it has to be removed.

IX. CONCLUSION

For the smart tram billing system, we successfully integrated RFID tags in this study. Overall, this paradigm contributes to shorter checkout times.

The billing procedure is more sophisticated than the standard billing method. Our model's smart billing contributes to time savings.

We also discussed safety precautions. future purposes.

X. SCOPE FOR FUTURE WORK

Depending on the market applications, several charging processes may be accomplished. Using a GSM module, for instance, can assist the consumer in obtaining all invoicing and product discount information.

What if there is a possibility of theft?

The card readers ought to be put near the exit.

Therefore, if there is a theft, the detector will pick it up and sound an alert if the individual leaves the merchandise in the cart unscanned and exits through the exit.

An alert if the individual leaves the merchandise in the cart unscanned and exits through the exit.

XI. REFERENCES

References include George Kennedy's Electronic Communication Systems, George M. Chute's Electronics in Industry, and V. K. Mehta's Principles of Electronics. • www.electronicsforu.com

Electronic Communication Systems by George Kennedy, Electronics in Industry by George M. Chute, Principles of Electronics by V. K. Mehta, Electronicsforu.com, and How Stuff Works may all be found at www.howstuffworks.com.