WORKING OF COMPONENTS:

Arduino UNO R3:

The Arduino Uno R3 is a versatile device that can be powered on using a USB connection or external power supply. It features a pre-installed bootloader program, which initializes the microcontroller, sets up configuration, and waits for a new program to be uploaded. Programming is done using the Arduino IDE, which is based on C and C++, allowing for easy interaction with sensors, actuators, and other components. The Arduino Uno R3 can be uploaded using a USB connection, and the Arduino IDE communicates with the board via the USB port. The microcontroller's flash memory stores the program instructions, and the CPU reads them sequentially to perform necessary operations. The Arduino Uno R3 supports serial communication and can interact with its environment, allowing for sense and response to inputs, calculations, decisions, and control of actuators. The program runs in an iterative process, allowing for continuous monitoring, response to changes, and updating outputs.

MFRC 522

The MFRC522 module is a wireless communication system that uses an integrated antenna to transmit and receive radio frequency signals, enabling communication with RFID tags or cards. It operates at **13.56 MHz**, a standard frequency for RFID systems. The module is initialized, detects RFID tags or cards, and supports various communication protocols, including ISO/IEC 14443A, for contactless smart cards. It can exchange data with the tag or card, perform authentication, and implement error detection and correction mechanisms. The received data can be processed by a microcontroller or other devices, enabling applications such as access control, identification, tracking, and authentication.

- The MFRC522 reader supports ISO/IEC 14443 A/MIFARE and NTAG.
- The reader can communicate with a microcontroller over a 4-pin SPI with a maximum data rate of 10 Mbps.
- 13.56 MHz comes under ISM (**Industrial, scientific and medical**) BAND under HF (**High Frequency**) band.

1. Integrated MF RC522
2. 13.56MHz contactless communication card chip.
3. The low-voltage, low-cost, small size of the non-contact card chip to read and write.
4. Working current： 13 – 26mA / DC 3.3V
5. Standby current： 10 – 13mA / DC 3.3V
6. Sleep current： <80uA
7. Peak current： <30mA
8. Working frequency： 13.56MHz
9. Card reading distance ： 0 ~ 60mm （Mifare1 card）

LCD DISPLAY (20X4):

The LCD display requires a power supply, typically 5V or 3.3V, to operate. Initialization involves sending specific commands to the controller chip, setting up the display's operating mode and preparing it for data and command reception. The LCD display communicates with the microcontroller using a parallel interface, sending data and command signals through multiple data pins. Control signals such as Register Select (RS), Read/Write (R/W), and Enable (EN) are used to latch data or command provided on the data pins. The microcontroller sends appropriate commands and data sequences to display characters or strings on the LCD.

Custom characters can be created using predefined patterns stored in the character generator RAM (CGRAM). Backlight control is possible using a backlight pin connected to the microcontroller. A refresh rate is required to ensure consistent display of characters, as the display does not retain character information once written.

As the name suggests, these LCDs are ideal for displaying only characters. A 20×4-character LCD, for example, can display 32 ASCII characters across two rows.If you look closely, you can see tiny rectangles for each character on the screen as well as the pixels that make up a character. Each of these rectangles is a grid of 5×8 pixels.

I2C DISPLAY MODULE:

The I2C display module requires a power supply, typically 5V or 3.3V, to operate. It communicates with the microcontroller using the I2C protocol, which uses SDA and SCL for data transmission and clock synchronization. The module needs to be initialized, configuring settings, and addressing its unique I2C address. The microcontroller sends commands and data to display characters, strings, and control display settings. The display module interprets these commands and updates the display accordingly. The module also controls the LED backlight, adjusting brightness and color. Regular refreshs are required to maintain the displayed information.

I2C PROTOCAL:

The I2C bus topology consists of multiple devices connected in a bus topology, with the master device initiating communication and controlling the bus. The bus requires two communication lines: Serial Data Line (SDA) and Serial Clock Line (SCL). The master device initiates communication and controls the bus, while slave devices respond to commands and provide or receive data. The bus topology includes start and stop conditions, addresses, data transfer, read and write operations, clock stretching, and multi-master configuration. The master device determines the direction of data transfer, while the slave device responds to data bytes. The SCL line provides clock pulses for data transmission, and the master device determines the direction of data transfer. The I2C protocol supports multi-master configuration, allowing multiple master devices to share the bus through arbitration and priority mechanisms.