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JSS SCIENCE AND TECHNOLOGY UNIVERSITY
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RFID DOOR LOCK

Synopsis submitted in partial fulfillment of Mini – Project (Event – 2)

IN

ENGINEERING PHYSICS

by

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DEPARTMENT OF PHYSICS
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JSS MAHAVIDYAPEETHA
JSS SCIENCE AND TECHNOLOGY UNIVERSITY
SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING

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This is to certify that the work entitled "RFID DOOR LOCK" is a bonafied work carried out by Monith Cheranda Muthanna, Prathviraj M.V, Dheeraj P, Ayush P, Aniruddha S, Anirudh V Roa and Santhosh K in Partial fulfillment for the mini project in ENGINEERING PHYSICS of Sri Jayachamarajendra College of Engineering, JSS Science and Technology University, Mysuru, during the year 2023-24.

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2. ………………………

Place: Mysuru
Date:

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Introduction

In the previous age, a normal Lock and key are used to lock the door and gate. But in this modern age, some houses, hotels, offices, and other places are using electronic door locks systems, these are basically keyless door locks i.e don't need a key to unlock the door. Several types of access control systems are used in electronic door locks to access the door. The most used access control systems are PIN/Password (Personal Identification Number), fingerprint, and RFID based electronic door locks systems.

In the RFID lock system, you need a particular card or key tag and put it in front of the RFID door locks system box (RFID Reader) to unlock the door. If you put the wrong card or key tag in front of the RFID door locks system box (RFID Reader) then the door would not unlock. This system is also known as the card door lock system or key card door lock system.

The RFID Door Lock with LCD and Servo project aims to create a secure and automated door access system using an Arduino microcontroller. This project integrates Radio Frequency Identification (RFID) technology, an LCD display, and a servo motor to control access through a door. It provides a convenient and effective solution for enhancing security in homes, offices, and industrial settings.

Working principle

The RFID Door Lock system operates using RFID technology integrated with an Arduino microcontroller. This system leverages several components working together seamlessly to ensure secure and automated access control. Here is a comprehensive, step-by-step breakdown of the working principle:

1. **System Initialization:** When the system is powered on, the Arduino initializes all the connected components, including the RFID reader, LCD display, and servo motor. The Arduino loads the list of authorized RFID tags from its memory.
2. **Idle State**: The system remains in an idle state, continuously waiting for an RFID tag to be presented to the RFID reader.
3. **RFID Tag Detection**: When a user presents an RFID tag to the RFID reader, it detects the presence of the tag within its electromagnetic field. The RFID reader is designed to emit radio waves that induce a current in the tag's antenna, allowing it to power up and transmit its unique ID.
4. **Reading RFID Tag**: The RFID reader reads the unique ID code from the tag. This code is a series of bytes that uniquely identifies the tag.
5. **Data Transmission to Arduino**: The RFID reader transmits the read ID code to the Arduino microcontroller via serial communication. The Arduino receives this data and prepares to process it.
6. **ID Verification Process**: The Arduino compares the received ID with the list of pre-stored authorized IDs. This list can be stored in the Arduino's EEPROM or an external memory module.

7. **Decision Making**: If the received ID matches any of the authorized IDs in the list, the Arduino determines that access should be granted. If the ID does not match any authorized IDs, access is denied.
8. **Feedback Display Initialization**: The Arduino sends a signal to the LCD display to show the current status of the access attempt. The LCD provides visual feedback to the user regarding the result of the ID verification process.
9. **Access Granted:** If the ID is authorized:
    a. The LCD displays a message such as "Access Granted" or "Welcome".
    b. The Arduino sends a signal to the servo motor to rotate to a specific angle that unlocks the door.
    c. The servo motor moves to the designated position, physically unlocking the door.
10. **Access Denied**: If the ID is not authorized:
    d. The LCD displays a message such as "Access Denied" or "Unauthorized Access".
    e. The Arduino does not send a signal to the servo motor, keeping the door locked.
11. **Timeout for Servo Motor**: After a brief period, typically a few seconds, the Arduino sends another signal to the servo motor to return to its original position, locking the door again. This ensures the door does not remain unlocked indefinitely after an authorized access.
12. **Power Management**: The Arduino continuously manages the power to all components, ensuring the RFID reader, LCD, and servo motor operate within their required voltage and current specifications.
13. **System Reset and Updates**: The Arduino can be programmed to allow updates to the list of authorized IDs, either through a serial connection to a computer. This enables easy management of access permissions.
14. **Error Handling**: The system includes error handling routines to manage scenarios such as read errors from the RFID reader, communication issues, or component malfunctions. The Arduino can display error messages on the LCD and take corrective actions.
15. **User Interface Enhancements**: The LCD can be used to display additional information, such as system status, instructions for users, etc.
16. **Physical Design Considerations**: The placement of the RFID reader, LCD, and servo motor are optimized for user convenience and security. The components are housed in secure enclosures to protect against tampering and environmental factors.

Components

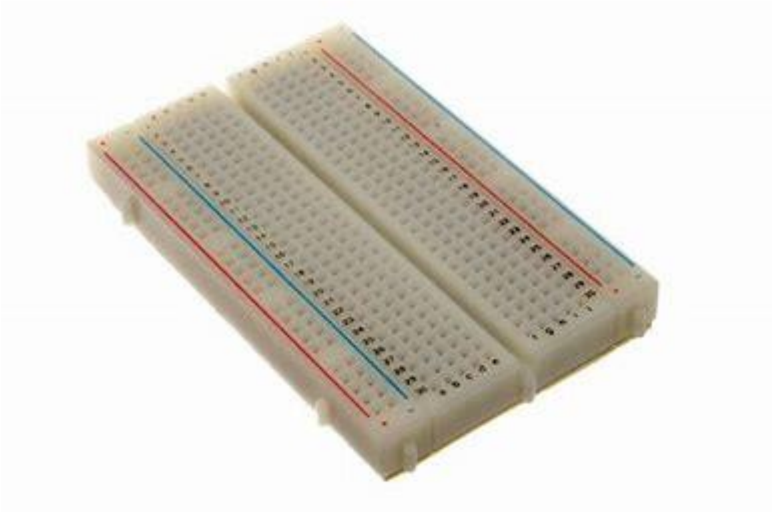
1.RFID

Radio Frequency Identification (RFID) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal, or person. It uses radio frequency to search, identify, track, and communicate with items and people.

Fig(i)

It is a method that is used to track or identify an object by radio transmission over the web. Data is digitally encoded in an RFID tag which might be read by the reader. This device works as a tag or label during which data is read from tags that are stored in the database through the reader as compared to traditional barcodes and QR codes. It is often read outside the road of sight either passive or active RFID.

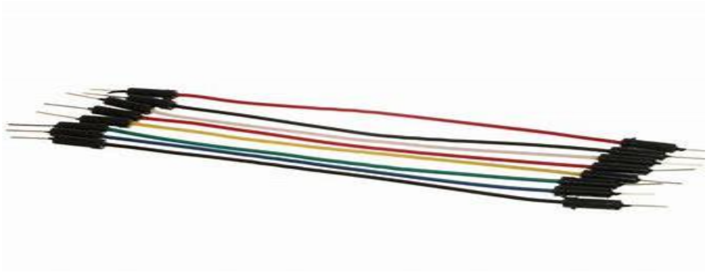
2.Breadboard



Fig(ii)

A Breadboard is simply a board for prototyping or building circuits on. It allows you to place components and connections on the board to make circuits without soldering. The holes in the breadboard take care of your connections by physically holding onto parts or wires where you put them and electrically connecting them inside the board. The ease of use and speed are great for learning and quick prototyping of simple circuits. More complex circuits and high frequency circuits are less suited to breadboarding. Breadboard circuits are also not ideal for long term use like circuits built on perfboard (protoboard) or PCB (printed circuit board), but they also don't have the soldering (protoboard), or design and manufacturing costs (PCBs).

3.Jumper wires



Fig(iii)

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with BREADBOARDS and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

4.Aurdino

Fig(iv)

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic 12 resonator, 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. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.

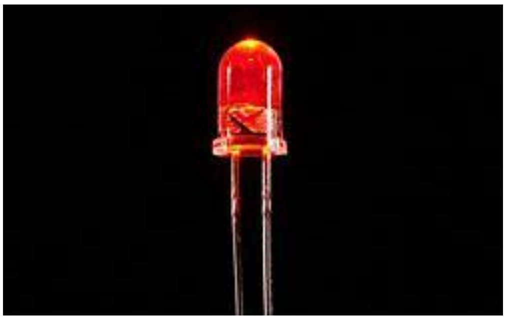
- ATmega328 Microcontroller- It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.
- ICSP pin - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- Power LED Indicator- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.
- Digital I/O pins- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- TX and RX LED's- The successful flow of data is represented by the lighting of these LED's. • AREF- The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- Reset button- It is used to add a Reset button to the connection.
- USB- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- Crystal Oscillator- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- Voltage Regulator- The voltage regulator converts the input voltage to 5V. • GND- Ground pins. The ground pin acts as a pin with zero voltage.
- Vin- It is the input voltage. • Analog Pins- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

5.9V Battery

Fig(v)

The 9V battery is an extremely common battery that was first used in transistor radios. It features a rectangular prism shape that utilizes a pair of snap connectors which are located at the top of the battery. A wide array of both large and small battery manufacturers produces versions of the 9V battery. Possible chemistries of primary (non-rechargeable) 9V batteries include Alkaline, Carbon-Zinc (Heavy Duty), Lithium. Possible chemistries of secondary (rechargeable) 9V batteries include nickel-cadmium (NiCd), nickel-metal hydride (NiMH), and lithium ion. The performance and application of the battery can vary greatly between different chemistries, meaning that some chemistries are better suited for some applications over others.

6.LED



Fig(vi)

The Light-emitting diode is a two-lead semiconductor light source. In 1962, Nick Holonyak has come up with the idea of a light-emitting diode, and he was working for the General Electric company. The LED is a special type of diode and they have similar electrical characteristics to a PN junction diode. Hence the LED allows the flow of current in the forward direction and blocks the current in the reverse direction. The LED occupies a small area which is less than 1 mm2. The LED function is very simple. Simply, a diode is a light-emitting diode. When the diode is forward biassed, the electrons and holes move quickly across the junction, constantly combining and removing one another. The electrons merge with the holes as they transition from n-type to p-type silicon, then vanish. As a result, it stabilizes the entire atom and provides a small burst of energy in a tiny packet of photons or light. The quantum theory underpins the operation of the light-emitting diode. According to quantum theory, energy is emitted from the photon when the electron descends from a higher energy level to a lower energy level. The energy difference between these two energy levels is equal to the photon energy. The current passes through the diode if the PN-junction diode is forward biassed. The passage of holes in the opposite direction of current and the flow of electrons in the current direction cause current flow in semiconductors. As a result of the movement of these charge carriers, recombination will occur. The electrons in the conduction band jump down to the valence band during recombination. Electrons emit electromagnetic energy in the form of photons when they leap from one band to the next, and the photon energy is equal to the forbidden energy gap. This is how LED functions.

7.Servo

A servo motor is an electric motor that adjusts its position, speed, or torque in response to controller inputs.

Fig(vii)

A servo motor consists of three main components:

- A motor: This can be either a DC motor or an AC motor depending on the power source and the application requirements. The motor provides the mechanical power to rotate or move the output shaft.
- A sensor: This can be either a potentiometer, an encoder, a resolver, or another device that measures the position, speed, or torque of the output shaft and sends feedback signals to the controller.
- A controller: This can be either an analog or a digital circuit that compares the feedback signals from the sensor with the desired setpoint signals from an external source (such as a computer or a joystick) and generates control signals to adjust the motor’s voltage or current accordingly.

The controller employs a closed-loop feedback system, adjusting the motor’s movement to closely align with the desired setpoint, maintaining strict accuracy.

The controller can also implement various control algorithms, such as proportional-integral-derivative (PID) control, fuzzy logic control, adaptive control, etc., to optimize the performance of the servo motor.

The basic working principle of a servo motor involves the controller receiving two types of input signals:

- A setpoint signal: This is an analog or digital signal that represents the desired position, speed, or torque of the output shaft.
- A feedback signal: This is an analog or digital signal that represents the actual position, speed, or torque of the output shaft measured by the sensor.

The controller compares these two signals and calculates an error signal that represents the difference between them.

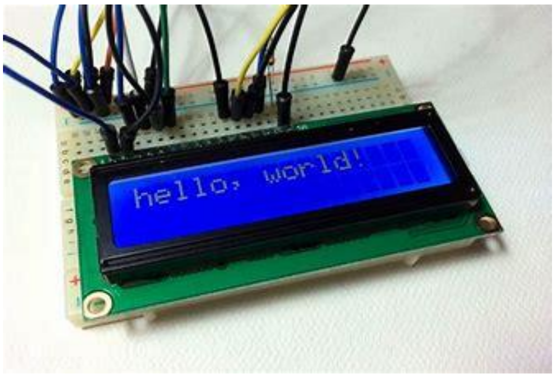
The error signal is then processed by a control algorithm (such as PID) that generates a control signal that determines how much voltage or current should be applied to the motor.

The control signal is sent to a power amplifier (such as an H-bridge) that converts it into an appropriate voltage or current level for driving the motor.

The motor then rotates or moves according to the control signal and changes its position, speed, or torque, and sends a new feedback signal to the controller.

The process repeats until the error signal becomes zero or negligible, indicating that the output shaft has reached the desired setpoint.

8.LCD display



Fig(viii)

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

9.Solder wire

Soldering electronic components involves joining them using a filler material (solder) that melts at a relatively low temperature.

Fig(ix)

The principle of soldering relies on several key concepts:

1. Melting Point: Solder is typically an alloy (e.g., tin-lead or tin-silver-copper) with a specific melting point lower than the components and the substrate (e.g., a printed circuit board). When heated, solder transitions from solid to liquid.
2. Solidification: Once the solder cools, it solidifies, forming a mechanical and electrical bond between the components.
3. Surface Tension: In its molten state, solder exhibits surface tension, allowing it to flow and spread across the surfaces it contacts.
4. Wetting: Effective soldering requires good wetting, where the liquid solder spreads out and adheres to the surfaces of the components and the substrate. Wetting is enhanced by flux, a chemical agent that cleans the surfaces and improves the flow of solder.
5. Heat Transfer: Heat is applied to the joint, typically using a soldering iron. The soldering iron must be at a higher temperature than the melting point of the solder to transfer sufficient heat to melt it.
6. Thermal Conductivity: The components and substrate must conduct heat effectively to ensure even melting and bonding without damaging sensitive parts.
7. Intermetallic Compounds: When solder cools and solidifies, it forms intermetallic compounds with the metals it contacts (e.g., copper on a PCB). These compounds are crucial for creating a strong and reliable electrical connection.
8. Electrical Pathways: The solidified solder forms a conductive path, allowing electrical current to flow between the joined components. The quality of this connection is critical for the functionality of the electronic circuit.

CODE USED FOR THE PROJECT USING ARDUINO IDE

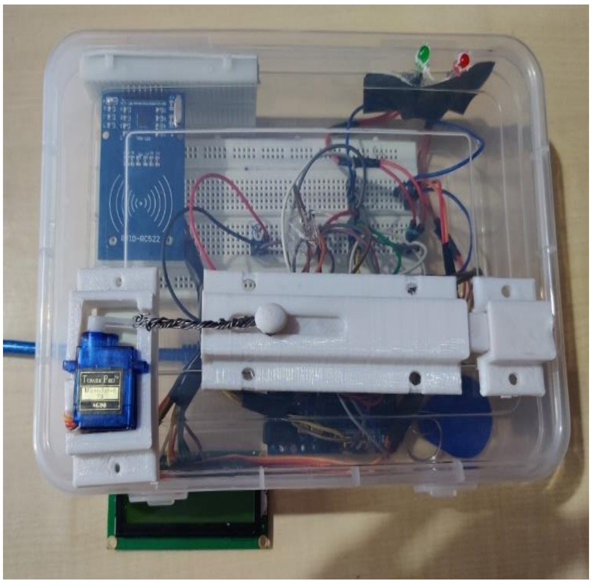
```
//include library

#include <SPI.h>
#include <MFRC522.h>
#include <Servo.h>
#include <LiquidCrystal.h>

//define pins

#define SS_PIN 10
#define RST_PIN 9
#define SERVO_PIN 2
Servo myservo;
#define ACCESS_DELAY 2000
#define DENIED_DELAY 1000
MFRC522 mfrc522(SS_PIN, RST_PIN);  // Create MFRC522 instance.
```

```
const int D4 = 4, D5 = 5, D6 = 6, D7 = 7, RS = 8, E = 3;

//code lcd

LiquidCrystal lcd(RS, E, D4, D5, D6, D7);

//setup code

void setup() {
  pinMode(A0, OUTPUT);
  pinMode(A1, OUTPUT);

  lcd.begin(16, 2);
  lcd.setCursor(0, 0);
  lcd.print("ENTER CARD.");
  Serial.begin(9600);  // Initiate a serial communication
  SPI.begin();         // Initiate SPI bus
  mfrc522.PCD_Init();  // Initiate MFRC522
  myservo.attach(SERVO_PIN);
  myservo.write(0);
  delay(2000);
  myservo.write(90);
  Serial.println("Put your card to the reader...");
  Serial.println("REGISTERED ACCESS ID'S:");
  Serial.println("43 A6 E0 FD");
  Serial.println("32 AD P5 SP");
  Serial.println("53 X6 F7 D8");

  Serial.println();
}

//looping statements

void loop() {

  // Look for new cards

  if (!mfrc522.PICC_IsNewCardPresent()) {
    return;
  }

  // Select one of the cards

  if (!mfrc522.PICC_ReadCardSerial()) {
```

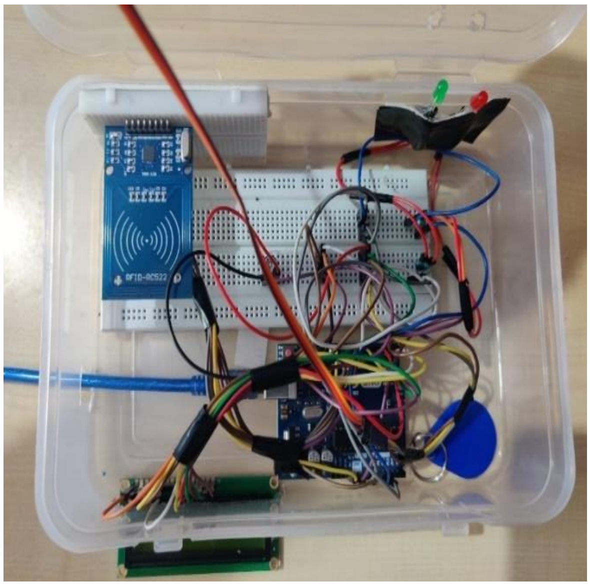
```
return;
}

//Show UID on serial monitor

Serial.print("ur entered UID tag :");
String content = "";
byte letter;
for (byte i = 0; i < mfrc522.uid.size; i++) {
  Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
  Serial.print(mfrc522.uid.uidByte[i], HEX);
  content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
  content.concat(String(mfrc522.uid.uidByte[i], HEX));
}
Serial.println();
content.toUpperCase();


//conditions

if (content.substring(1) == "43 A6 E0 FD")  //change here the UID of the card
{
  lcd.setCursor(0, 0);
  lcd.print("Access granted.");
  digitalWrite(A1, HIGH);
  delay(2000);
  Serial.println("REGISTERED ACCESS ID'S:");
  Serial.println("43 A6 E0 FD");
  Serial.println("32 AD P5 SP");
  Serial.println("53 X6 F7 D8");
  Serial.print("Message : ");

  Serial.println("Authorized access");
  Serial.println();
  myservo.write(0);
  delay(4000);
  lcd.clear();
  digitalWrite(A1, LOW);
  lcd.print("ENTER CARD.");
  myservo.write(90);

} else {
  digitalWrite(A0, HIGH);
  lcd.print("Access denied.");
```

```
  delay(2000);
   digitalWrite(A0, LOW);
   lcd.clear();
   lcd.print("ENTER CARD.");

   lcd.setCursor(0, 0);
   Serial.println("REGISTERED ACCESS ID'S:");
   Serial.println("43 A6 E0 FD");
   Serial.println("32 AD P5 SP");
   Serial.println("53 X6 F7 D8");
   Serial.print("Message : ");

   Serial.println(" Access denied");
   delay(DENIED_DELAY);
  }
}
```

REAL CIRCUIT IMAGE

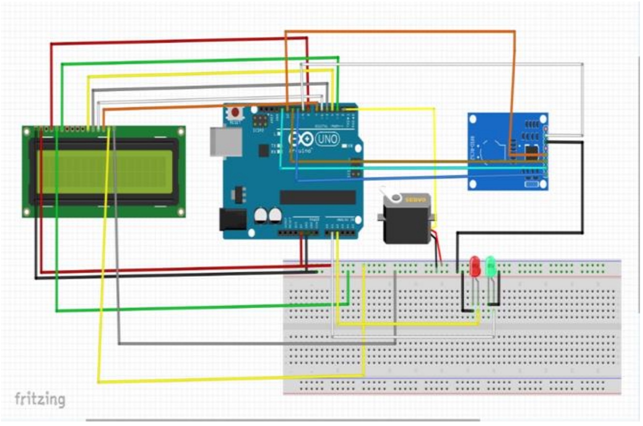


Fig(x)



Fig(xi)

VIRTUAL CIRCUIT IMAGE



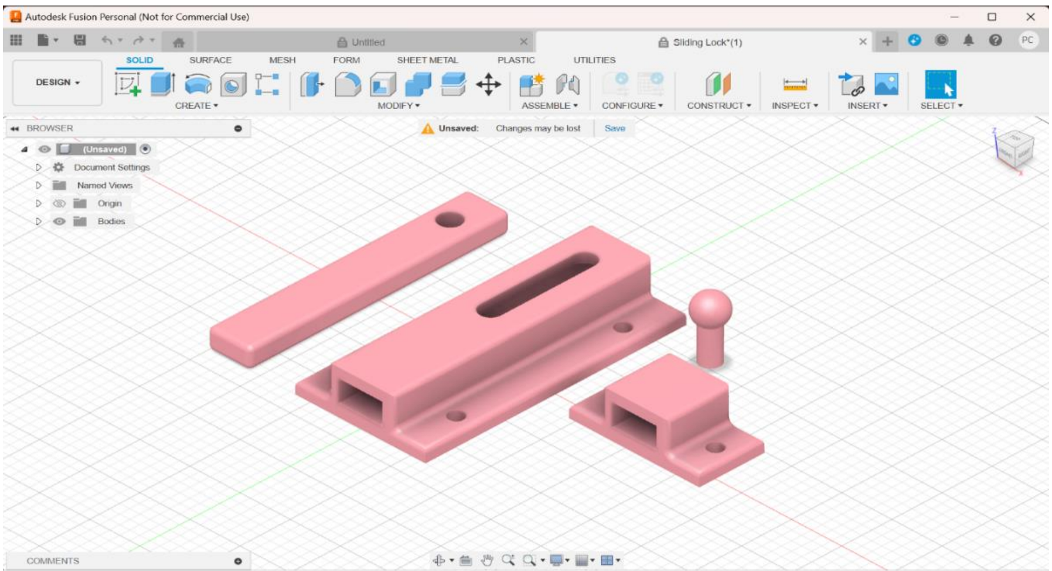
Fig(xii)

3D Modelling

3D modelling is the process of creating three-dimensional representations of an object or a surface. During the 3D modelling process, you can determine an object's size, shape, and texture. The process works with points, lines, and polygons to create the 3D shapes within the software.

A 3D model is essentially made up of vertices, which come together to form a mesh and act as the core of the 3D model. Each point on the model can be manipulated to change the shape. By using coordinate data, the software identifies the location of each vertical and horizontal point, all relative to a reference point.

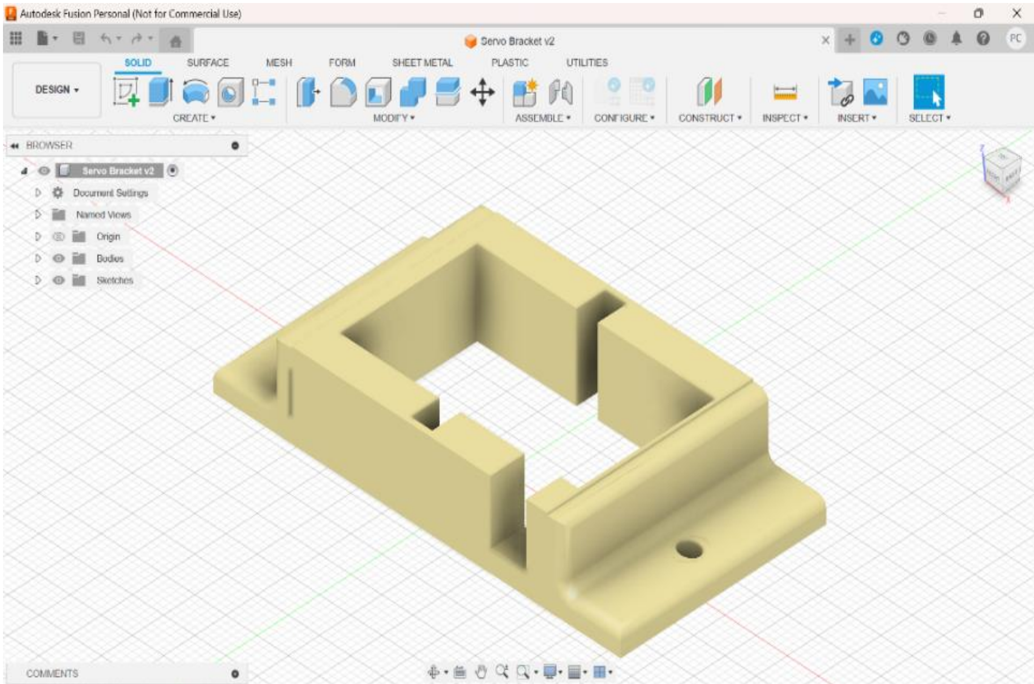
The most common way to begin making a 3D model is to start with a basic shape – a cube, box, sphere, or whatever you think is best suited. From your starter shape, you can start moulding and refining it into what you desire.



Fig(xiii)

Many industries utilise 3D modelling for a range of projects; there are likely loads of 3D

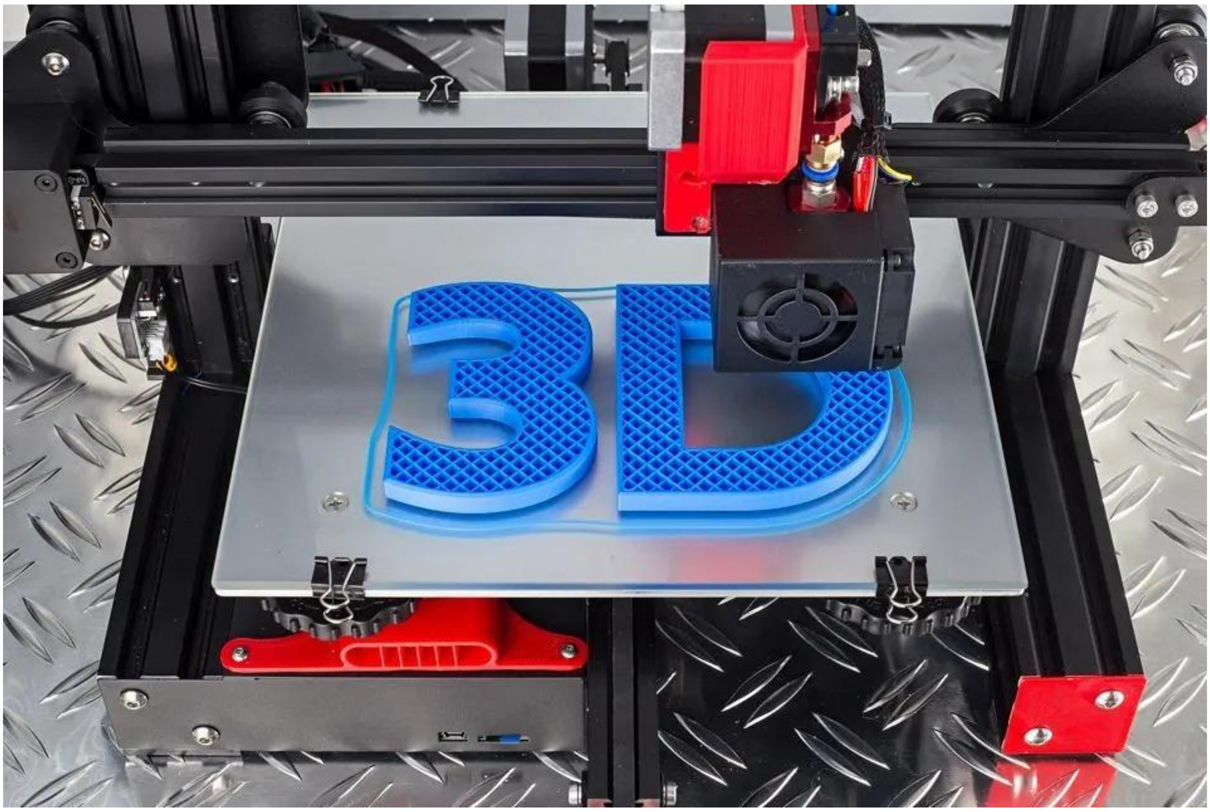
modelled items we use without even realising its involvement. With 3D modelling, the opportunities are endless. It’s a truly versatile medium that can be used for an array of different areas. It’s used in game development, product design, architecture,
Animation, 3D printing etc.   The software we have used here is 360 fusion software.



Fig(xiv)

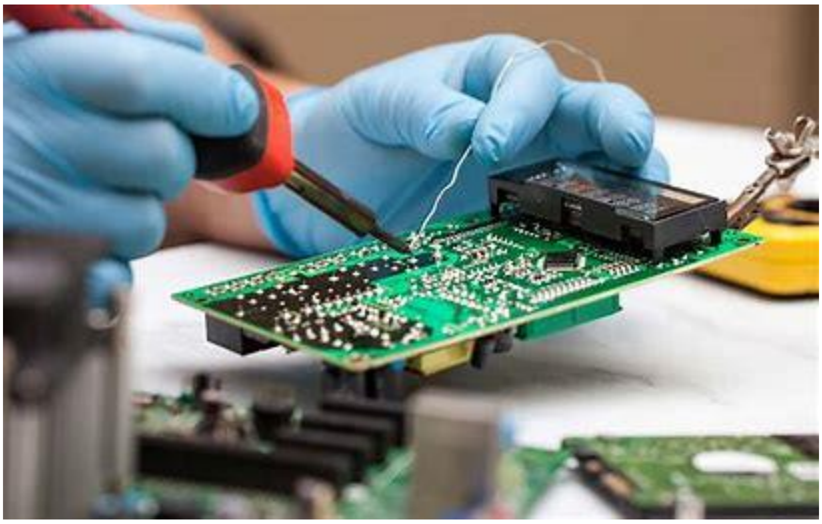
3D PRINTING

3D Printing is the process of creating objects by depositing layers of material on top of one another. 3D Printing is called additive manufacturing (AM) instead of traditional subtractive methods like CNC milling when used for industrial production.
This technology has been around for about four decades, invented in the early 1980s. While 3D printing started out as a slow and costly technique, extensive technological developments have made today’s AM technologies more affordable and faster than ever.
A digital 3D model is sliced into hundreds of thin layers by dedicated software to export in G-code format. This 3D printing format is a language that the 3D printer reads to know precisely when and where to deposit material.
Each layer corresponds to the exact 2D shape of one section or slice of the object. For example, if you were 3D Printing a pyramid, the first layer (bottom) would be a flat square, and the last layer (at the very top) would be a tiny dot.
The layers are consecutively 3D printed one at a time until you obtain the fully printed object. 3D printing can used for rapid prototyping, end use parts, Tools, Jigs, and Fixtures, Mass customization etc. Our 3D model weighed was 54g after it was printed



Fig(xv)

Soldering



Fig(xvi)

Soldering is a joining process used to join different types of metals together by melting solder. Solder is a metal alloy usually made of tin and lead which is melted using a hot iron. The iron is heated to temperatures above 600 degrees Fahrenheit which then cools to create a strong electrical bond.

Solder is melted by using heat from an iron connected to a temperature controller. It is heated up to temperatures beyond its melting point at around 600 degrees Fahrenheit which then causes it to melt, which then cools creating the soldered joint.

As well as creating strong electrical joints solder can also be removed using a desoldering tool.

Solder is a metal alloy used to create strong permanent bonds; such as copper joining in circuit boards and copper pipe joints. It can also be supplied in two different types and diameters, lead and lead free and also can be between .032” and .062”. Inside the solder core is the flux, a material used to strengthen and improve its mechanical properties.
Soldering is used in various applications, including:

- Plumbing (joining copper pipes)
- Electronics (joining electronic components, wires, and cables)
- Metalwork (joining sheet metal objects, automobile radiator cores, and other metal assemblies)
- Jewelry making
- Stained glass artistry

Research On RFID

RFID, or Radio Frequency Identification, is a technology that uses radio waves to transmit data between a tag attached to an object and a reader. Here’s some background on RFID technology:

1. **Components:** RFID systems typically consist of RFID tags (or transponders), readers (or interrogators), and an antenna. Tags contain a microchip and an antenna to receive and transmit data. Readers emit radio waves to communicate with tags and receive signals back.

2. **Types of RFID Tags:**
    - **Passive RFID Tags**: These do not have a power source of their own and are powered by the electromagnetic energy transmitted from the RFID reader. They are smaller and cheaper but have shorter read ranges.
    - **Active RFID Tags**: These have their own power source (battery) and can transmit signals over longer distances. They are larger and more expensive but have better performance in terms of range and reliability.

3. **Operating Frequencies**: RFID operates at different frequencies depending on the application:
    - **Low Frequency (LF)**: Typically, 125 kHz to 134 kHz, used for access control and animal tagging.
    - **High Frequency (HF)**: Around 13.56 MHz, used for payment cards, passports, and inventory tracking.
    - **Ultra-High Frequency (UHF)**: 860-960 MHz, used for supply chain management, retail inventory, and vehicle tracking.

- **Microwave Frequency**: 2.45 GHz, used for specialized applications like toll collection and some industrial uses.

Applications:

- **Environmental Monitoring**: RFID sensors can monitor temperature, humidity, and other conditions in warehouses, cold chain logistics, and agricultural settings.
- **Asset Tracking**: RFID sensors can monitor the condition (e.g., temperature, moisture) of assets in transit or storage, ensuring quality control and compliance.
- **Healthcare**: Used for tracking medical supplies and monitoring temperature-sensitive medications to ensure they remain within safe conditions.
- **Smart Packaging**: RFID sensors can monitor the condition of perishable goods during transport and storage, providing real-time data for quality assurance.

BASICS OF RFID TECHNOLOGY

RFID Technology: RFID involves the use of radio waves to communicate between an RFID tag and an RFID reader (or interrogator). The tag consists of a microchip that stores data and an antenna that transmits data to the reader when activated by radio waves.

Components of RFID Sensors:

- **RFID Tag**: Contains a microchip that stores data (such as identification or sensor data) and an antenna to communicate with the RFID reader.
- **RFID Reader**: Emits radio waves to activate the RFID tag and receive data transmitted by the tag.
- **Sensor**: Built into the RFID tag or integrated with it, the sensor can measure various environmental parameters such as temperature, humidity, pressure, motion, light, and more.

Working Principle:

- When an RFID sensor enters the electromagnetic field of an RFID reader, the reader emits radio waves.
- These waves power the RFID tag, including its sensor components, allowing them to function and transmit data.
- The sensor gathers data from its environment (e.g., temperature) and modulates this data into the signal transmitted back to the RFID reader.

Data Transmission:

- The RFID tag, now activated and powered by the reader's signal, transmits its stored data (including sensor measurements) back to the RFID reader.
- The RFID reader receives this data and forwards it to a connected system or computer for processing and analysis.

- The data can be used for real-time monitoring, logging historical trends, triggering alerts based on predefined thresholds, or integrating with other systems for further action.

RC522 RFID SENSOR AND ITS PINS:

The RC522 module typically has 8 pins: SDA, SCK, MOSI, MISO, IRQ, VCC, GND, and RST. Each pin serves a specific function in facilitating communication between the sensor and the microcontroller.

Fig(xvii)

- **VCC (3.3v):-** VCC pin is connects to the Arduino 3.3V pin to supply power to the module. Connecting it to the 5v Arduino pin can destroy the RFID module.
- **RST:-** This pin is use to reset the module.
- **GND:-** This pin connects to the GND pin of Arduino.
- **IRQ:-** This is blocking or interrupt pin that can alert the microcontroller when it comes around the RFID tag.
- **MISO/SCL/TX:-** This pin is Master-In-Slave-Out. It acts as serial data output and connects to the Arduino RX pin.
- **MOSI:-** Master-Out-Slave-In pin is SPI input to the RC522 module.
- **SCK:**– Serial Clock is accepting clock pulses provided by Arduino.
- **SS / SDA / RX:-** The SDA (Serial Data) pin facilitates data transmission between the RFID module and the microcontroller. This pin usually connects to the Arduino TX pin.

SPECIFICATIONS OF RC522:

- Integrated MF RC522
- 13.56MHz contactless communication card chip.
- The low-voltage, low-cost, small size of the non-contact card chip to read and write.
- Working current：13 – 26mA / DC 3.3V
- Standby current：10 – 13mA / DC 3.3V
- Sleep current：<80uA

- Peak current：<30mA
- Working frequency：13.56MHz
- Card reading distance ：0～60mm

Advantages of RFID Door Lock System

- Improving Convenience
- Enhancing Security
- Increasing Operational Efficiency
- Flexible Integration
- Cost Savings
- Automation Control

Disadvantages of RFID Door Lock System

- Installation Costs
- Power Dependency
- Limited Range
- Network Attacks
- Privacy Concerns

Applications

- Contactless payment systems
- Inventory management systems
- Customer loyalty programs
- Animal identification and tracking systems
- Race timing systems
- Toll collection systems
- Parking management systems
- Asset tracking systems
- Sports timing systems
- Event ticketing and registration

Conclusion

The RFID Door Lock with LCD and Servo project offers a sophisticated and efficient solution for enhancing security and automating access control. By integrating RFID technology with a microcontroller, an LCD display, and a servo motor, the system provides a robust mechanism to manage entry and ensure only authorized individuals gain access to secured areas.

Key advantages of this project include:

- Enhanced Security: With unique RFID tags, the system ensures that only pre-authorized users can unlock the door, significantly reducing the risk of unauthorized access.
- User-Friendly Interface: The LCD display provides clear and immediate feedback, making it easy for users to understand their access status.
- Automation: The servo motor automates the locking and unlocking process, eliminating the need for manual intervention and increasing convenience.
- Scalability and Flexibility: The system can be easily expanded to include multiple access points and integrated with larger security frameworks, making it suitable for various settings such as homes, offices, and industrial facilities.

Implementing this RFID-based door lock system not only improves security but also enhances the overall efficiency and user experience. The project serves as a practical demonstration of how modern technology can be harnessed to create smart, secure, and automated environments.

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