

## 1. INTRODUCTION

With the rising interest for security, framework with high reliance and fast reaction frameworks are real need for industries and the ventures. Radio-Frequency Identification is the most significant region of future and is increasing huge consideration from a logical world and enterprises. In this work, RFID based door access control utilizing Arduino is created. We used RFID ID tag and RFID reader, which is used to match the data on tag with the data in the database program which leads to movement of door by confirming whether the data is correct and/or incorrect. Opening of the door uses servo motor that gets its feed from Arduino board. The main aim of the project is to design a RFID based door unlocking/locking system using Arduino, only those people who register will be able to enter using their card. The main controlling device of the project is Arduino UNO microcontroller. RFID reader and TAGS, Relay along with solenoid lock and Buzzer interfaced to the arduino UNO. To open and close door user need to scan the RFID tag on RFID reader, then the command will go to the microcontroller, The microcontroller will check that if the card is registered or not. If it is registered, it will access the door through solenoid lock to let the person in. If it is not registered it will activate the buzzer and the door will not open. Here relay works as a switch to LOCK/UNLOCK the door. To achieve this task arduino loaded program written in embedded C language.



**FIG: RFID LOCK FULL MODULE**

## 2. LITERATURE SURVEY

This literature survey explores various projects and research works focused on improving door security systems using RFID technology integrated with Arduino and other components. The surveyed works span from 2019 to 2024, showcasing advancements in smart security systems.

- **2024 - Advanced Security Integration**

**Title:** *Arduino-Based RFID Door Lock Security System with Piezoelectric Sensor*

**Authors:** M. Giron et al.

**Summary:** Combines **RFID**, and **Piezo sensors** for improved security. It offers robust monitoring and communication features using Arduino.

- **2023 - Security + Attendance Automation**

**Title:** *Enhancing Room Security and Automating Class Attendance Using ID Cards*

**Authors:** Shravan Bhat et al.

**Summary:** Integrates **RFID and GSM** to manage both room security and **automated attendance systems** for classrooms.

- **2020 - LCD-Based Lock Prototype**

**Title:** *Smart Door Lock System Development Prototype using RFID Technology ID-12*

**Authors:** Siti Aisyah et al.

**Summary:** Uses **RFID ID-12**, LCD, and Relay with **Arduino Uno** to demonstrate a smart lock prototype.

- **2019 - Internet-Connected RFID System**

**Title:** *Design and Implementation of an RFID-Based Door Lock System*

**Authors:** Isah Watson et al.

**Summary:** Uses **ESP8266** Wi-Fi module, RFID (MFRC522), and **EEPROM** for memory, enabling **IoT connectivity** in the system.

- **2019 - Multi-Factor Security**

**Title:** *Electronic Door Lock using RFID and Password Based on Arduino*

**Authors:** Ni Ni San Hlaing et al.

**Summary:** Combines **RFID with keypad-based password authentication**, controlling a **solenoid lock** for dual-layer security.

### 3. SYSTEM ANALYSIS

#### 3.1 EXISTING SYSTEM

Presently we use a smart lock which is an electronic and mechanical locking device. The user uses their smartphone or a key fob to wirelessly verify and mechanically unlock the door. Virtual keys can be sent by SMS text message or email, enabling access to guests or service personnel. Once received, these encrypted digital keys allow access to the smart lock for a present period of time.

#### DISADVANTAGES OF EXISTING SYSTEM:

- Smart locks can cost significantly more than standard lock-and-key systems.
- you may need a pro to install the lock and sync it to your Bluetooth and Wi-Fi.
- The possibility of not able to open the door when the battery of smartphone is down.
- Violated by IT experts who can create unauthorized fake access codes with smartphones



**FIG: EXISTING SYSTEM DIAGRAM**

### 3.2 PROPOSED SYSTEM

- Using an RFID-Reader we need to tap the on reader.
- Now the reader will read the card and check the information on the card.
- Card data is already programmed in the Arduino UNO.
- If the card is validated then it passes the information to the relay switch.
- Relay switch opens the Lock.
- GSM sends SMS alerts to the registered mobile.

#### ADVANTAGES OF THE PROPOSED SYSTEM:

- Cost is effective and Smart Automation.
- Open source in hardware doesn't need an external programmer.
- RFID chip has a unique serial number that cannot be changed.
- RFID tags have a greater operating range.
- SMS Alerts through Mobile phone for authorized and unauthorized access.



FIG: PROPOSED SYSTEM

### **3.3 MODULES**

#### **BUZZER MODE**

It will produce a beep sound when the unauthorized card is tapped on the RFID reader.

#### **RFID-READER**

The card is tapped on RFID-Reader, and it reads the card.

#### **RELAY**

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The relay is used for switching purposes to open or close the lock.

#### **SOLENOID LOCK**

It is used to Open and Close the Lock.

#### **GSM MODULE**

If the tag is unrecognized, the system activates a buzzer as a security alert and **sends an SMS notification via the GSM module** to a predefined mobile number, alerting the concerned authority of the unauthorized access attempt and also for authorized access.

## **4. SOFTWARE REQUIREMENT SPECIFICATION**

### **4.1 SOFTWARE REQUIREMENTS:**

- Arduino IDE : Open Source.
- Operating System : Windows 10

### **4.2 HARDWARE REQUIREMENTS:**

- Arduino UNO.
- Perf-board
- Buzzer.
- LED.
- Relay Switch.
- Jumper Wires.
- Power Supply.
- RFID-Reader
- Solenoid lock
- GSM Module

## 5 SYSTEM DESIGN

### 5.1 E-R Diagram:

This is an ER (Entity-Relationship) Diagram for an RFID-Based Electronic Door Lock System using Arduino.

#### 1. USER

- Attributes:
    - User\_ID – Unique identifier for each user.
    - Name – Name of the user.
  - Relationship:
    - owns → RFID\_Tags
- 

#### 2. RFID\_Tags

- Attributes:
    - Tag\_ID – Unique identifier of the RFID tag.
    - Serial No. – Hardware serial number of the tag.
  - Relationship:
    - owned by USER
    - validates → Arduino\_uno
- 

#### 3. Arduino\_uno

- Attributes:
    - Arduino\_ID – Unique ID for the Arduino controller.
  - Relationships:
    - validates RFID\_Tags – Checks if the scanned RFID tag is valid.
    - controls → DOOR\_Lock
    - logs → Access\_Log
    - triggers → Buzzer
-

#### 4. DOOR\_Lock

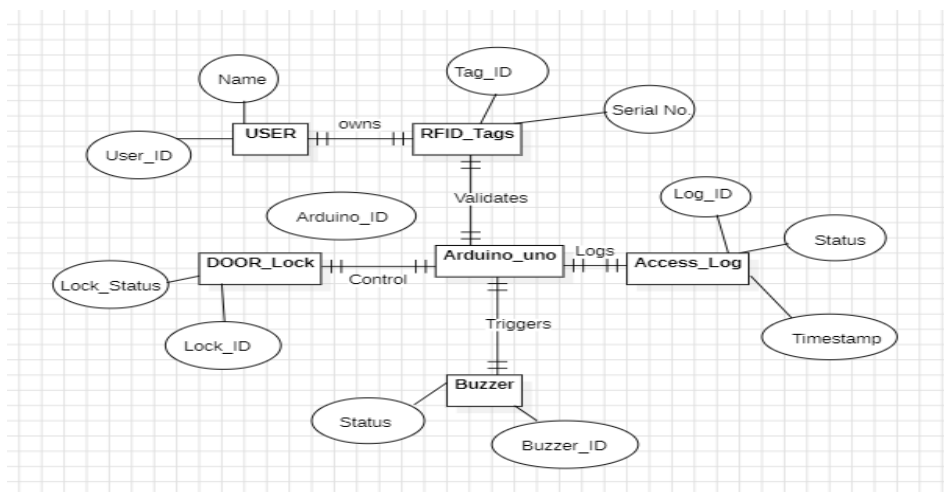
- Attributes:
    - Lock\_ID – Identifier for the lock device.
    - Lock\_Status – Indicates if the lock is locked or unlocked.
  - Relationship:
    - controlled by Arduino\_uno
- 

#### 5. Access\_Log

- Attributes:
    - Log\_ID – Unique ID for each log entry.
    - Status – Indicates success/failure of access attempt.
    - Timestamp – Date and time of the access attempt.
  - Relationship:
    - logged by Arduino\_uno
- 

#### 6. Buzzer

- Attributes:
  - Buzzer\_ID – Unique ID of the buzzer.
  - Status – Whether buzzer is ON or OFF.
- Relationship:
  - triggered by Arduino\_uno – When access is denied or warning is needed.



**FIG: E-R Diagram**

## 5.2 SYSTEM ARCHITECTURE:

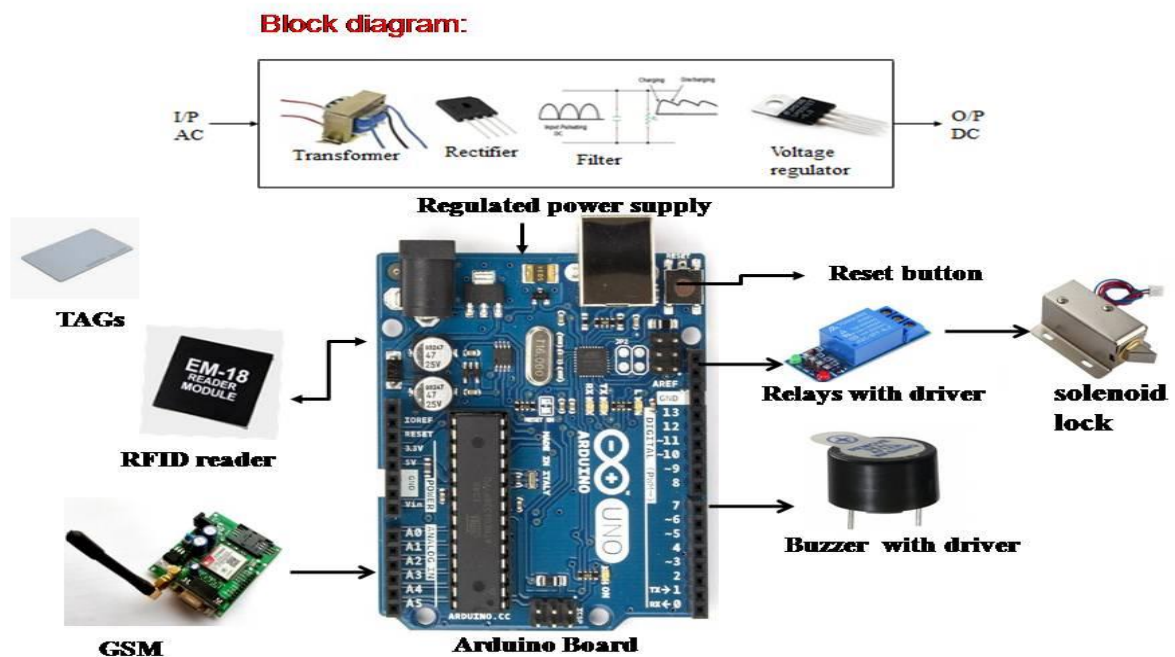
The diagram you've shared illustrates the system architecture of an Arduino-based electronic door lock using RFID, with additional components like a GSM module, buzzer, and solenoid lock.

### Key Components:

- RFID Tags & Reader (EM-18): Used to identify users.
- Arduino Uno: Controls the entire system by validating tag IDs.
- Relay Module: Acts as a switch to control the lock.
- Solenoid Lock: Locks/unlocks the door based on access.
- Buzzer: Gives sound feedback for access granted/denied.
- GSM Module: Sends SMS alerts about access events.
- Power Supply: Converts AC to regulated DC for components.

### Benefits:

- Improves door security.
- Sends alerts remotely using GSM.
- Easy to build with low cost and high efficiency.



## **5.3 UML DIAGRAMS**

The UML stands for Unified modelling language, is a standardized general-purpose visual modelling language in the field of Software Engineering. It is used for specifying, visualizing, constructing, and documenting the primary artifacts of the software system. It helps in designing and characterizing, especially those software systems that incorporate the concept of Object orientation. It describes the working of both the software and hardware systems.

The Object Management Group (OMG) is an association of several companies that controls the open standard UML. The OMG was established to build an open standard that mainly supports the interoperability of object-oriented systems. It is not restricted within the boundaries, but it can also be utilized for modelling the non-software systems. The OMG is best recognized for the Common Object Request Broker Architecture (CORBA) standards.

### **UML Specifying:**

Specifying means building models that are precise, unambiguous and complete. In particular, the UML address the specification of all the important analysis, design and implementation decisions that must be made in developing and displaying a software intensive system.

### **UML Visualization:**

The UML includes both graphical and textual representation. It makes easy to visualize the system and for better understanding.

### **UML Constructing:**

UML models can be directly connected to a variety of programming languages and it is sufficiently expressive and free from any ambiguity to permit the direct execution of models.

### **BUILDING BLOCKS OF UML:**

The vocabulary of the UML encompasses 3 kinds of building blocks.

- Things.
- Relationships.
- Diagrams.

Things: Things are the data abstractions that are first class citizens in a model. Things are of 4 types Structural Things, Behavioural Things, Grouping Things, An-notational Things.

Relationships: Relationships tie the things together. Relationships in the UML are Dependency, Association, Generalization, Specialization.

## **UML DIAGRAMS:**

A diagram is the graphical presentation of a set of elements, most often rendered as a connected graph of vertices (things) and arcs (relationships).

There are two types of diagrams, they are:

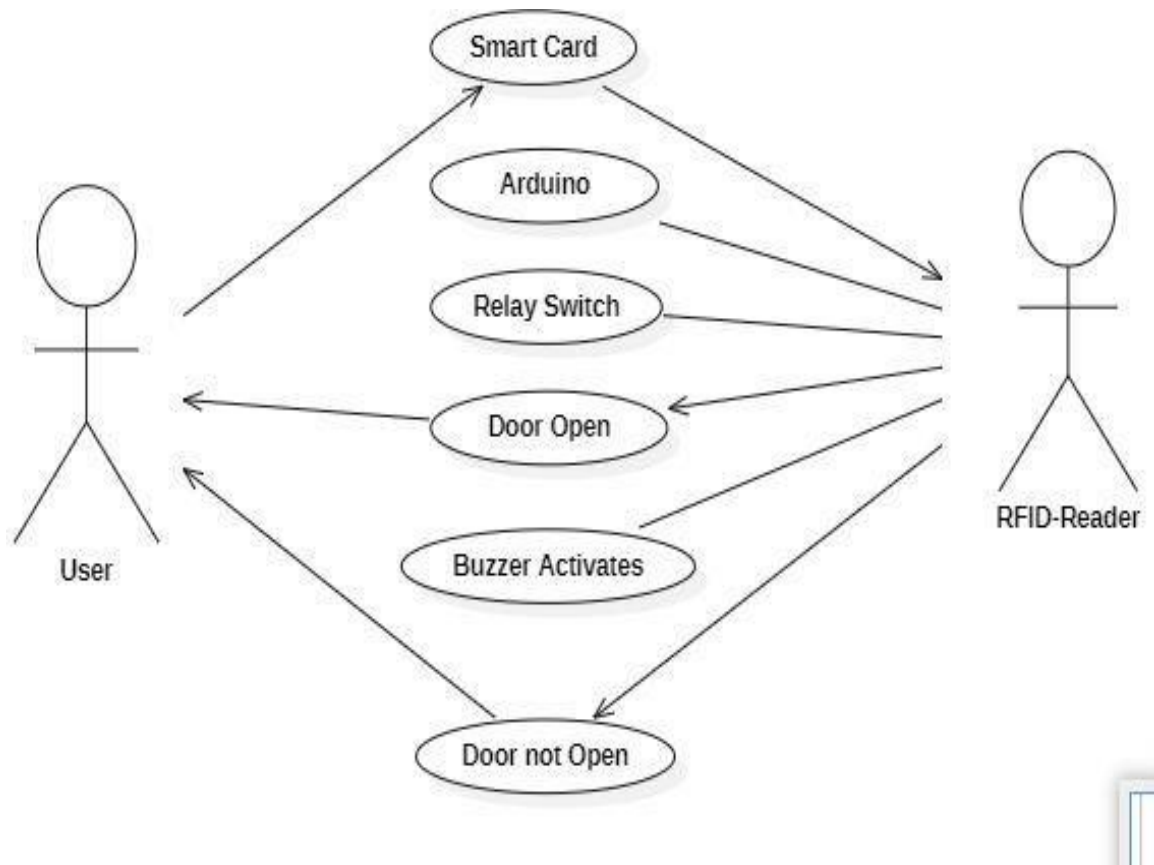
- Structural Diagrams
- Behavioural Diagrams

**STRUCTURAL DIAGRAMS** – Capture static aspects or structure of a system. Structural Diagrams include: Component Diagrams, Object Diagrams, Class Diagrams and Deployment Diagrams.

**BEHAVIOUR DIAGRAMS** – Capture dynamic aspects or behaviour of the system. Behaviour diagrams include: Use Case Diagrams, State Diagrams, Activity Diagrams and Interaction Diagrams.

## USE CASE DIAGRAM

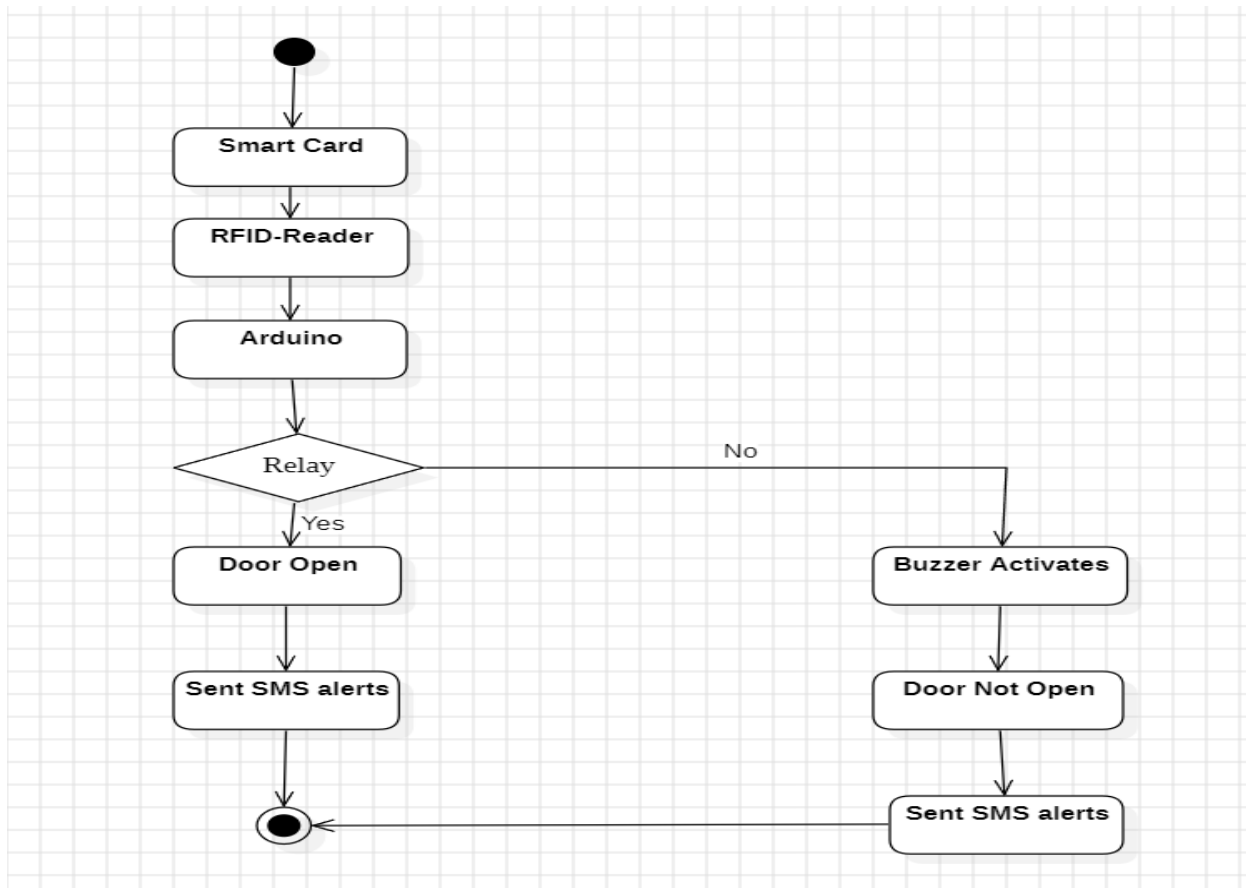
A use case diagram is to represent dynamic behaviour of system. It encapsulates the system's functionality by incorporating use cases, actors, their relationships. It models the tasks, services, functions required by system/subsystem of application. It depicts the High-level functionality of a system and also tells how the user handles a system.



**FIG: USE CASE DIAGRAM**

## ACTIVITY DIAGRAM

- Activity diagram is another important diagram in UML to describe the dynamic aspects of the system.
- Activity diagram is basically a flowchart to represent the flow from one activity to another activity.
- The activity can be described as an operation of the system.
- The control flow is drawn from one operation to another.
- This flow can be sequential, branched, or concurrent.

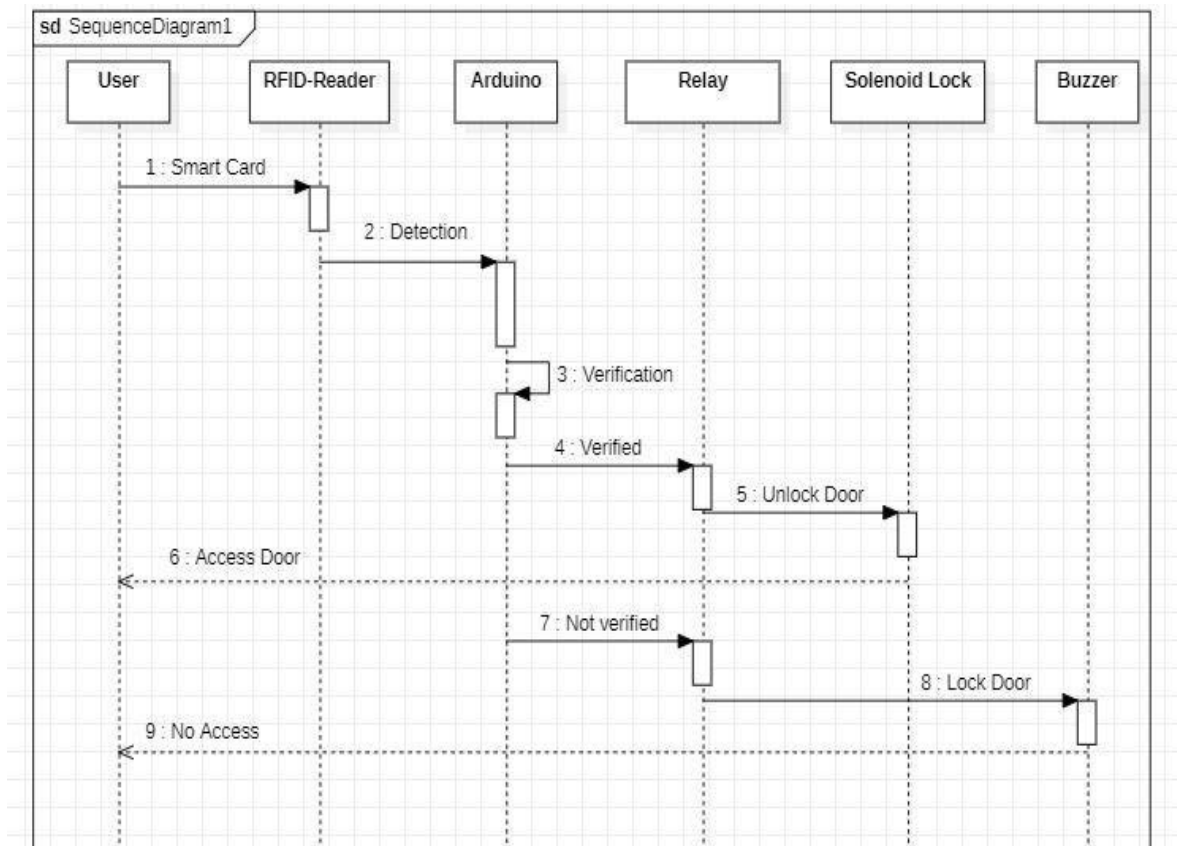


**FIG: ACTIVITY DIAGRAM**

## SEQUENCE DIAGRAM

The sequence diagram represents the flow of messages in the system and is also termed as an event diagram. It helps in envisioning several dynamic scenarios. It is a portrays the communication between any two lifelines as a time-ordered sequence of events, such that these lifelines took part at the run time. In UML, lifeline represents by a vertical bar, whereas the message flow is represented by vertical dotted line that extends across the bottom of the page. It incorporates the iterations a well branching

- To model high-level interaction among active objects within a system.
- To model interaction among objects inside a collaboration realizing a use case.
- It either models generic interactions or some certain instances of interaction.

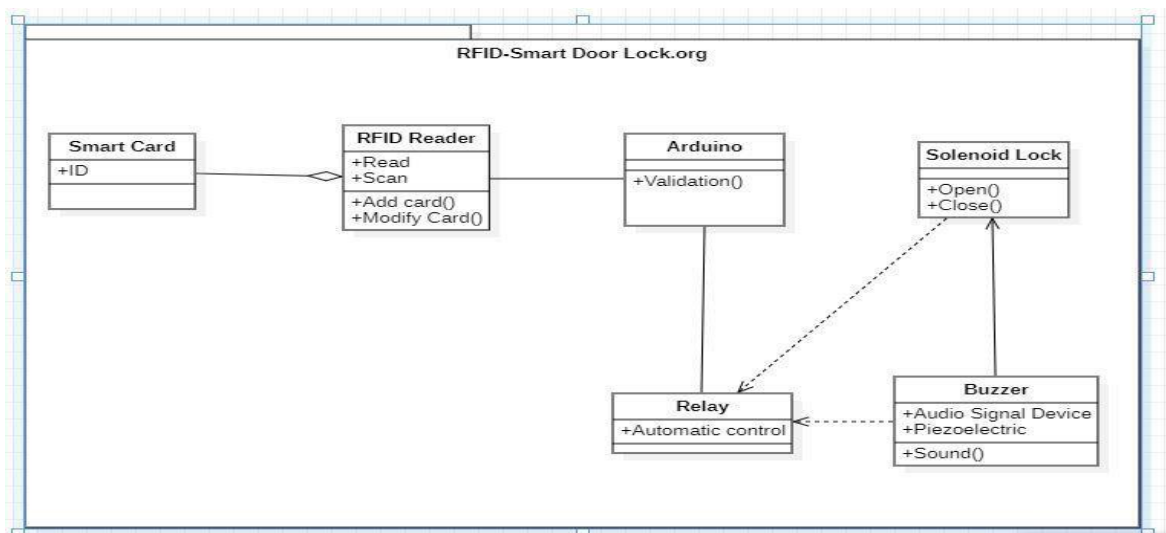


**FIG: SEQUENCE DIAGRAM**

## CLASS DIAGRAM

Class diagram is a structural diagram.

- It is a main building block of any object-oriented solution.
- It shows classes, attributes, & operations of each class & the relation between each class.

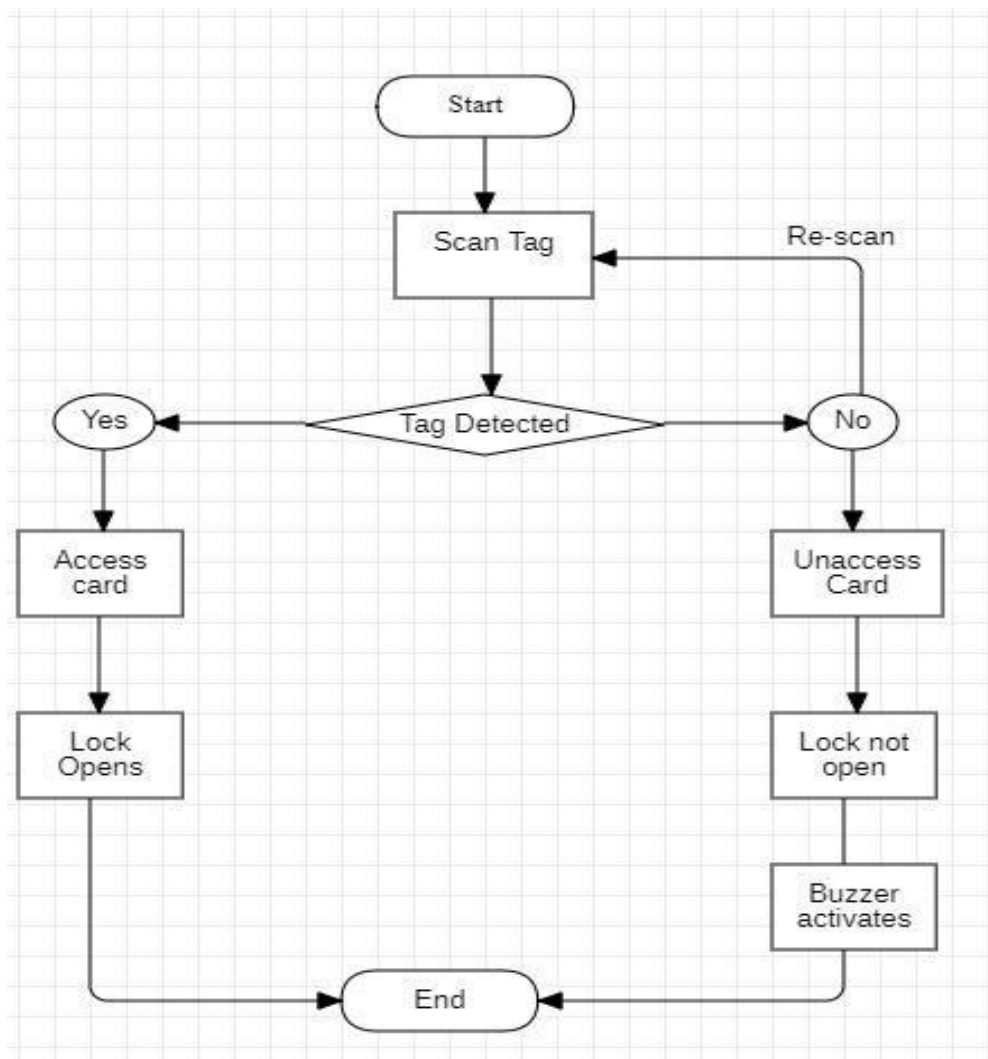


**FIG: CLASS DIAGRAM**

## FLOW CHART

To detect the object, after starting then it will check for the connectivity with the devices like Ultrasonic sensor and Arduino, etc., and observe for any object detection. If any object detects it will send the alert to the light, buzzer or vibrator through the switch if not it will again wait for the system alert. This distance will tell us if any object is near the module or not and according to that the alert signals will be controlled.

The main task was to avoid use of delay because we have to continuously read from the ultrasonic sensors and also at the same time, we have to control signals which requires the use of delay function. So, we have used the timer one library which is used to repetitively measure a period of time in microseconds and at the end of each period, an interrupt function will be called. In this function, we will read from the sensors and in the loop function, we will control alert signals.



**FIG: FLOW CHART**

## **6 SYSTEM IMPLEMENTATION**

### **6.1 TOOLS & TECHNOLOGIES USED:**

- Arduino UNO.
- Perf-board
- Buzzer.
- LED.
- Relay Switch.
- Jumper Wires.
- Power Supply.
- RFID-Reader
- GSM Module
- Solenoid lock

## ARDUINO UNO



**FIG: ARDUINO**

### INTRODUCTION TO MICRO-CONTROLLERS:

- The Arduino Uno is a microcontroller board which has ATmega328 from the AVR family.
- There are 14 digital input/output pins, 6 Analog pins and 16MHz ceramic resonator.
- USB connection, power jack and also a reset button is used.
- Its software is supported by a number of libraries that makes the programming easier.

### ARDUINO UNO SPECIFICATIONS:

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 131 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20 MHz

- On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
- 4/8/16/32K Bytes of In-System Self-Programmable Flash program memory
- (ATmega48PA/88PA/168PA/328P)
- 256/512/512/1K Bytes EEPROM (ATmega48PA/88PA/168PA/328P)
- 512/1K/1K/2K Bytes Internal SRAM (ATmega48PA/88PA/168PA/328P)
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data retention: 20 years at 85°C/100 years at 25°C(1)
- Optional Boot Code Section with Independent Lock Bits
- In-System Programming by On-chip Boot Program
- True Read-While-Write Operation
- Programming Lock for Software Security

## **PERIPHERAL FEATURES**

- Two 8-bit Timer/Counters with Separate Pre scaler and Compare Mode
- One 16-bit Timer/Counter with Separate Pre scaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Six PWM Channels
- 8-channel 10-bit ADC in TQFP and QFN/MLF package
- Temperature Measurement
- 6-channel 10-bit ADC in PDIP Package
- Temperature Measurement
- Programmable Serial USART
- Master/Slave SPI Serial Interface
- Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator
- Interrupt and Wake-up on Pin Change

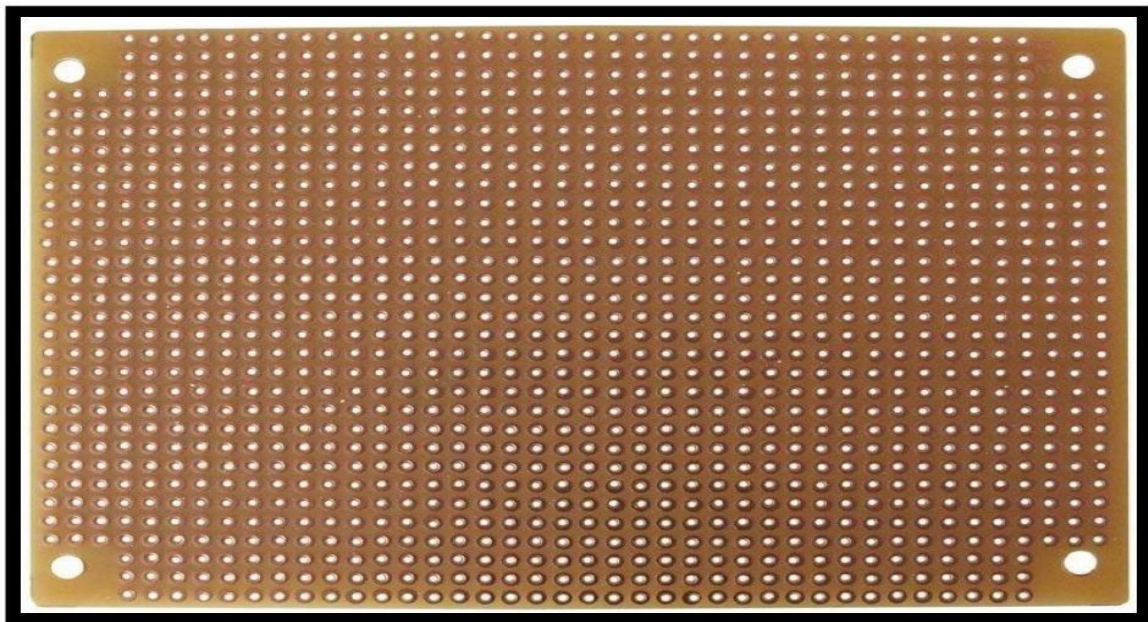
## **PERF-BOARD**

Perf-board is material for prototyping electronic circuits (also called DOT PCBs). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually being a square grid

of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive Perf-board may have pads on only one side of board, while better quality Perf-board can have pads on both sides (plate-through holes). Since each pad is electrically isolated, the builder makes all connections with either wire wraps miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate is typically made a paper laminated with phenolic resin (such as FR-2) or a fiberglass-reinforced epoxy laminates (FR-4).

The 0.1 inches (2.54 mm) grid system accommodates integrated circuits in DIP packages and many other types of through-hole components. Perf-board is not designed for prototyping of surface mount devices. Before building a circuit on Perf-board, the locations of components and connections are typically planned in detail on paper or with software tools. Small scale prototype however, are often built ad hoc, using an oversized Perf-board. Circuits assembled on various of Perf-board are not necessarily fragile but may be less impact- resistant than printed circuit boards.

Perf-board differs from strip board in that each pad on Perf-board is isolated. Strip board is Made with rows of copper conductors that form default connections, which are broken into Isolated segments as required by scraping through the copper. This is similar to the pattern default connections on a solderless breadboard. However, the absence of default connect a On the Perf-board gives the designer more freedom in positioning components lends itself More readily to software-aided design than strip board or breadboard.



**FIG: PERFBOARD**

## **BUZZER**

A buzzer or beeper is an audio signaling device, which may be mechanical, electro-mechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

### **TYPES OF BUZZERS:**

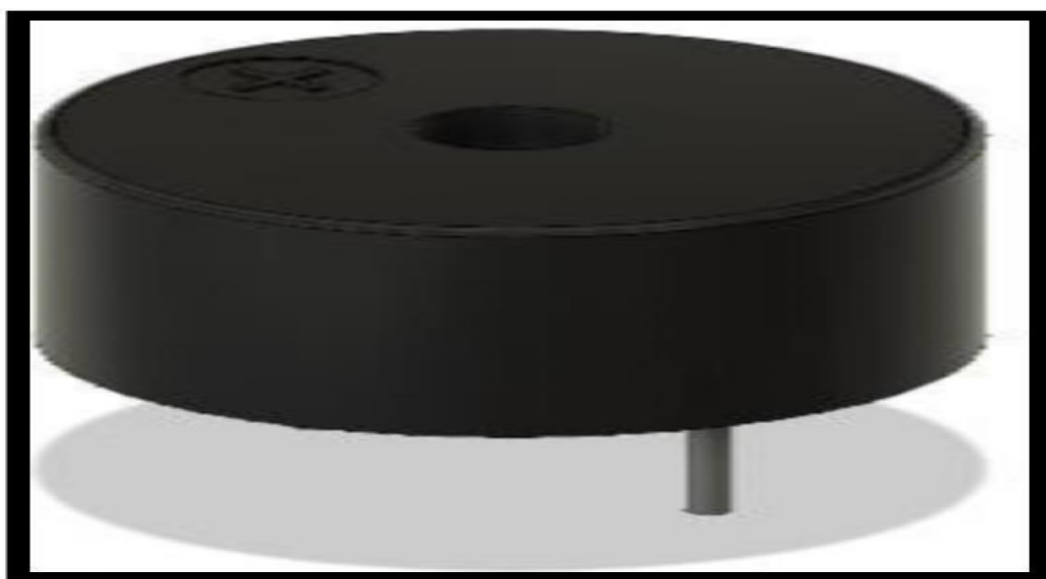
#### **ELECTROMECHANICAL:**

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz (the contacts buzz at line frequency if powered by alternating current) Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

#### **MECHANICAL:**

A joy buzzer is an example of a purely mechanical buzzer and they require drivers. Other examples of them are doorbells.

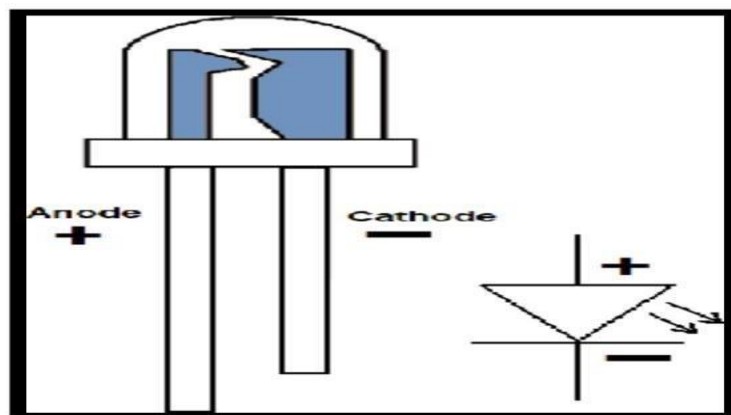
**PIEZOELECTRIC:** A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep. A piezoelectric buzzer/beeper also depends on acoustic cavity resonance or Helmholtz resonance to produce an audible beep.



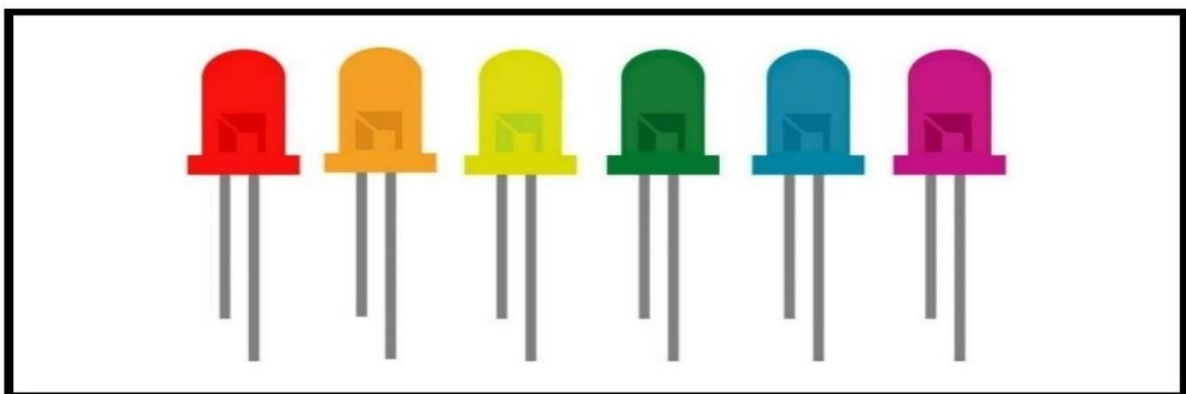
**FIG: PIEZO-ELECTRIC BUZZER**

## LED

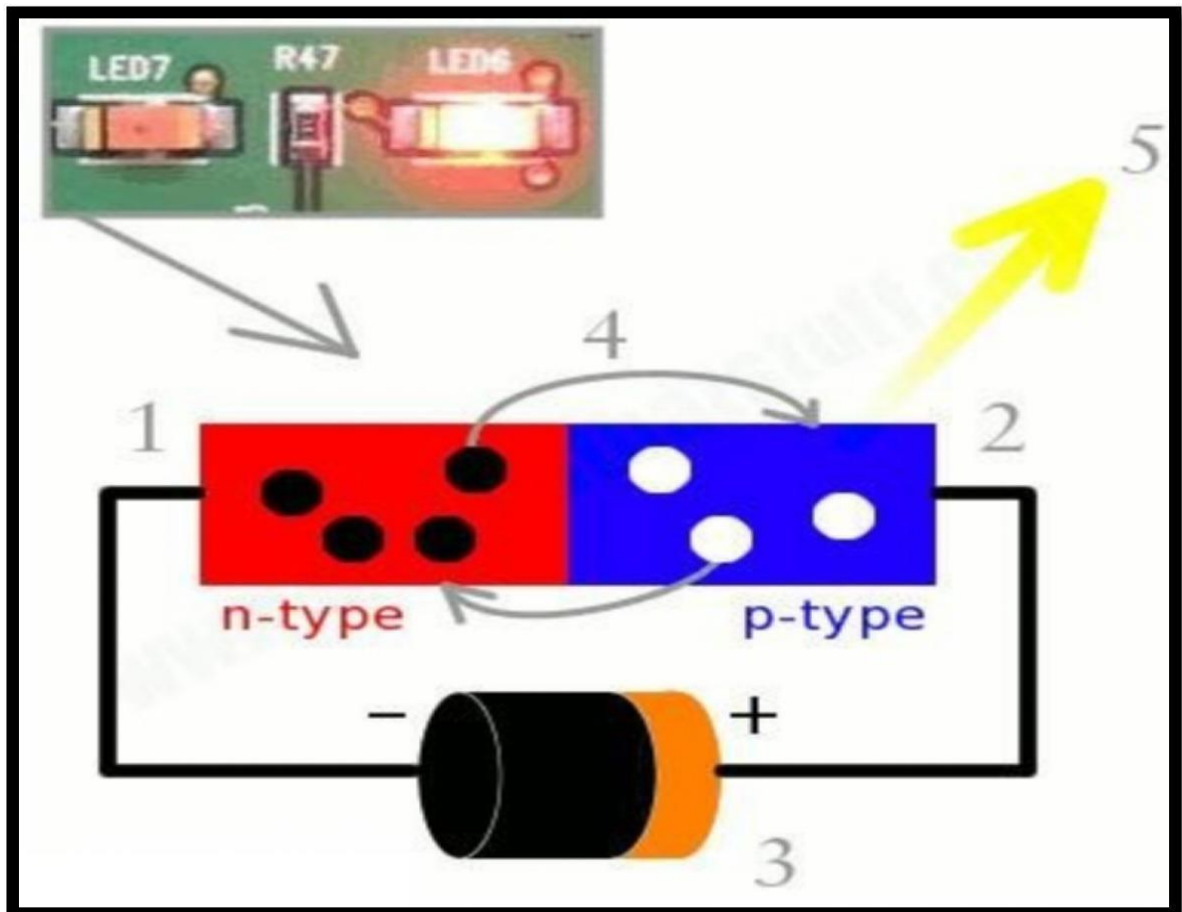
A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device. A light-emitting diode (LED) is a two-lead semiconductor [HYPERLINK](#) light source. It is a p-n junction. [HYPER LINK](#) diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy). When the diode is forward biased, then the electrons & holes are moving fast across the junction and they are combining constantly, removing one another out. Soon after the electrons are moving from the n- type to the p-type silicon, it combines with the holes, then it disappears. Hence it makes the complete atom & more stable and it gives the little burst of energy in the form of a tiny packet or photon of light.



**FIG: LED CONFIGURATION**



**FIG: LED**



**FIG: WORKING OF LED**

The above diagram shows how the light emitting diode works and the step-by-step process of the diagram.

- From the diagram, we can observe that the N-type silicon is in red colour and it contains the electrons, they are indicated by the black circles.
- The P- type silicon is blue colour and contains holes, they indicated by the white circle.

The power supply across the p-n junction makes the diode forward biased and pushing the electrons from n-type to p-type. Pushing the holes in the opposite direction. Electron and holes at the junction are combined.

## RELAY

A **relay** is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must

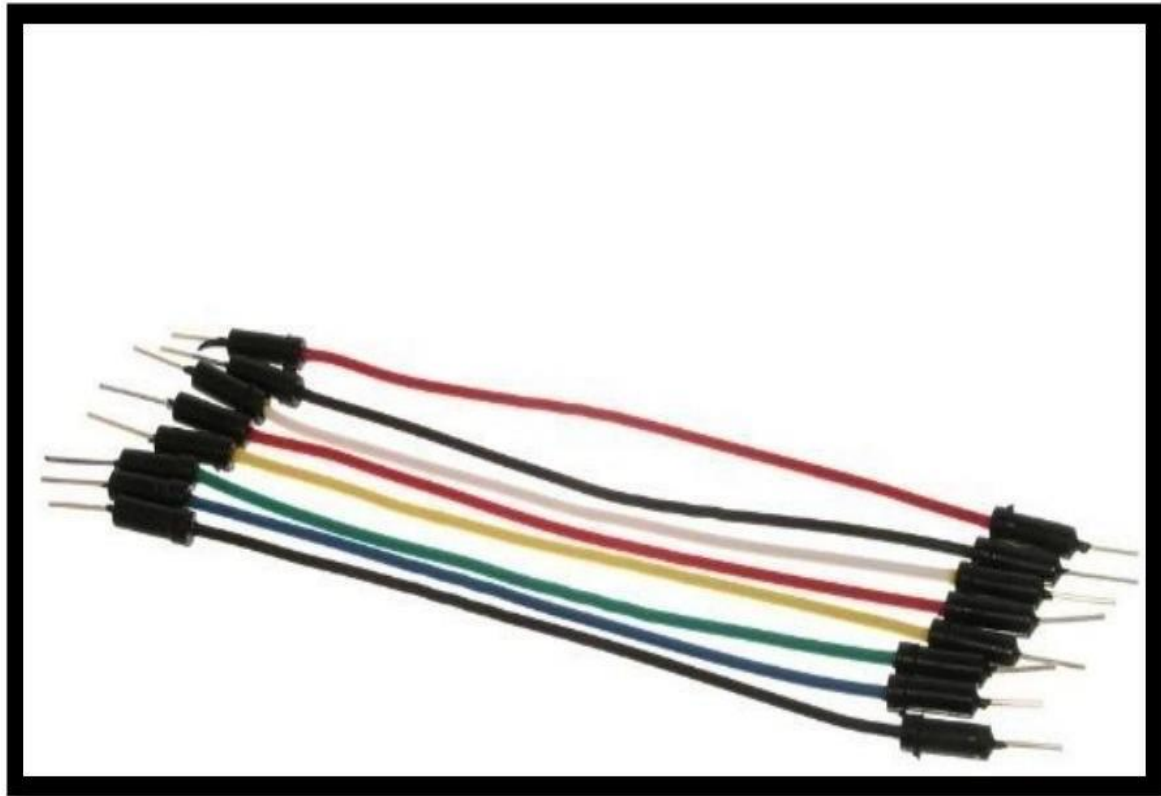
be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".



**FIG: Relay Switch**

## **JUMPER WIRES**

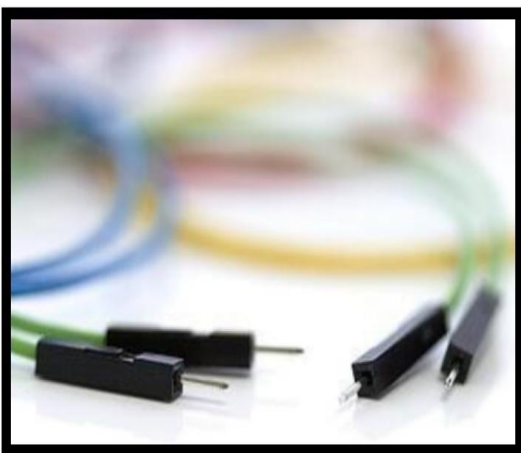
Stranded 22AWG jump wires with solid tips. A jumper wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without the soldering. Individual jump wires are fitted by inserting their “end connectors” into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.



**FIG: JUMPER WIRES**

### **TYPES OF JUMPER WIRES:**

Jumper wires typically come in three versions: male-to-male, male-to-female and female- to female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. Male-to-male jumper wires are the most common and what you likely will use most often. When connecting two ports on a breadboard, a male-to-male wire is what you'll need.



**FIG: MALE TO MALE & FEMALE TO FEMALE JUMPER WIRES**

## **POWER SUPPLY**

A power supply is a hardware component that supplies power to an electrical device. It receives power from an electrical outlet and converts the current from AC (alternating current) to DC (direct current), which is what the computer requires. It also regulates the voltage to an adequate amount, which allows the computer to run smoothly without overheating. The power supply is an integral part of any computer and must function correctly for the rest of the components to work. 12 Volt DC 1 Amp power supply is suitable for powering a wide range of applications including CCTV cameras and wireless routers. Features: 100% Brand New Excellent Quality Short Circuit, Over Voltage & Over Current Protection. Meet CEC Energy Efficiency Level IV Incredibly Low Fault Rates No Minimum Load.

This power supply is a regulated Centre Positive power supply and has a 2.1mm x 5.5mm Jack it's plug design is for Indian power socket. So, no plug converter is required. Compact size & light weight. High Reliability. Regulated Stable Voltage. Good quality SMPS Based Adapter Power LED Monitor (LED Glow when in Use) Stabilized Output, low ripple & low interference Single Output Voltage High Efficiency & low energy consumption Input - 100- 240 VAC 50/60hZ Category - Switch Mode Power Adaptor (SMPS) Output Type - DC Output - 12Volts 1Amp. Powerful 12v 12w 1A max Current Draw. Replaces lower amped adapters 12v 0.5A 1A. 1.5A etc. Smart Replacement Gadget Power Supply for LED, SMD, LED Strip, RGB LED Strip Ideal for Routers / Modems / Mobile Phones / Mp3 players / POS Machines etc. Best for Routers, Wi-Fi Routers security/spy camera receiver and some advanced cameras CCTV, Gadgets, Portable Players, Set Top Boxes, best for Toys etc., Charging or any gadgets as per the rating of the device, please study and then buy as this a very technical item only works as per its precise current outputs This power supply is an ideal replacement for a wireless network router such as the Net gear DG834, DG834GT, DG934 etc. Plus, a range of many other wireless routers. You will need to check the DC socket size & power rating with the supplier of the router you are using as we cannot confirm it will work.

## **EM 18 RFID Reader**

RFID is an acronym for Radio Frequency Identification. RFID (radio frequency identification) is a technology that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object,

animal, or person. RFID is coming into increasing use in industry as an alternative to the bar code. The advantage of RFID is that it does not require direct contact or line-of-sight scanning.

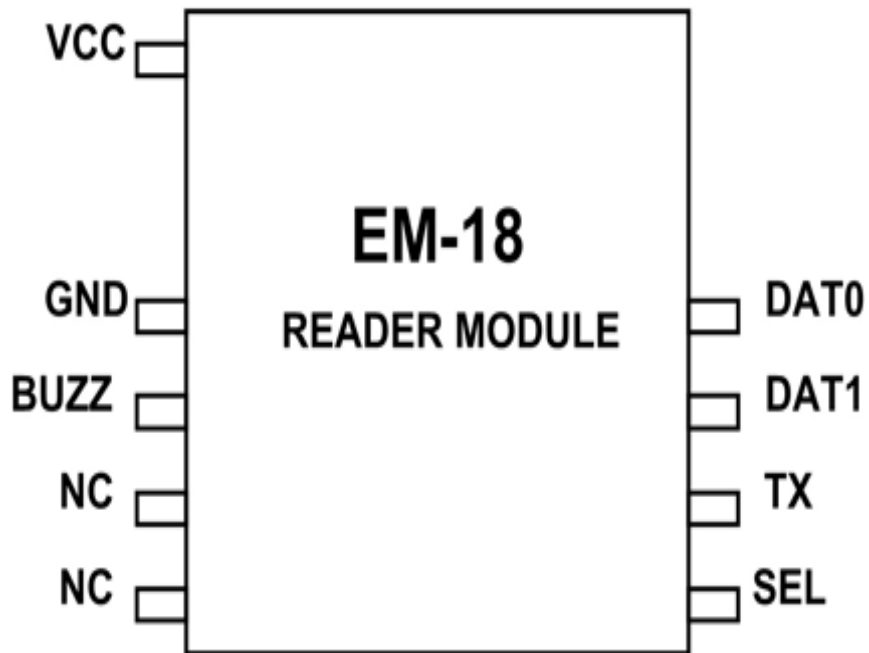
An RFID system consists of three components: an antenna and transceiver (often combined into one reader) and a transponder (the tag). The antenna uses radio frequency waves to transmit a signal that activates the transponder. When activated, the tag transmits data back to the antenna. The data is used to notify a programmable logic controller that an action should occur. Low-frequency RFID systems (30 KHz to 500 KHz) have short transmission ranges (generally less than six feet). High-frequency RFID systems (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) offer longer transmission ranges (more than 90 feet). In general RFID is the higher the frequency, the more expensive the system. RFID is sometimes called dedicated “**short range communication (DSRC).**”

Radio Frequency Identification (RFID) is a means of identifying a person or object using a radio frequency transmission. The technology can be used to identify, track, sort or detect a wide variety of objects. Communication takes place between a reader (interrogator) and a transponder (tag). Tags can either be active (powered by battery) or passive (powered by the reader field), and come in various forms. Some variants of tags and readers are shown RFID Tag and RFID Reader respectively.



**FIG: EM18 RFID Reader**

**EM18 RFID Reader** is a module which reads the ID information stored in **RFID TAGS**. This ID information is unique for every TAG which cannot be copied



### **EM-18 Pin Configuration**

EM-18 is a nine pin device. Among nine pins, 2 pins are not connected, so we basically have to consider seven terminals.

Pin Number	Description
VCC	Should be connected to positive of power source.
GND	Should be connected to ground.
BUZZ	Should be connected to BUZZER
NC	No Connection
NC	No Connection
SEL	SEL=1 then o/p =RS232 SEL=0then o/p=WEIGAND
TX	DATA is given out through TX of RS232
DATA1	WEIGAND interface DATA HIGH pin
DATA0	WEIGAND interface DATA LOW pin

## EM-18 Features and Specifications

- Operating voltage of EM-18: +4.5V to +5.5V
- Current consumption:50mA
- Can operate on LOW power
- Operating temperature: 0°C to +80°C
- Operating frequency:125KHz
- Communication parameter:9600bps
- Reading distance: 10cm, depending on TAG
- Integrated Antenna

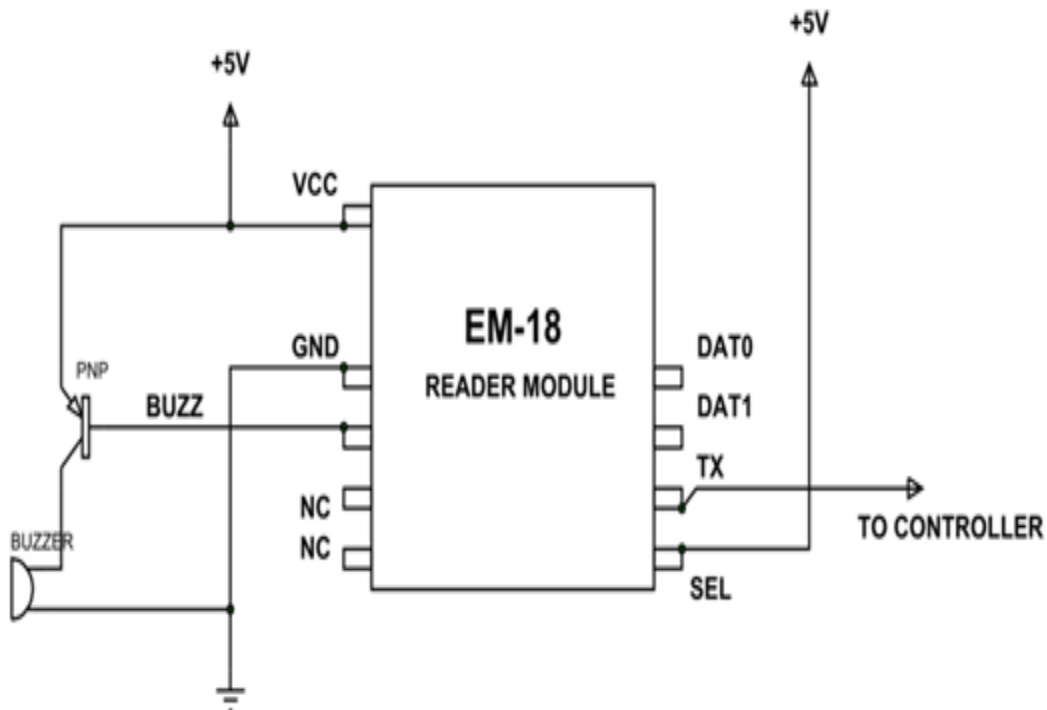
## How to Use EM-18 RFID Module

**EM-18** is used like any other sensor module. First we choose the mode of communication between MODULE and CONTROLLER. Next we will program the controller to receive data from module to display. Next power the system. When a tag is brought near the MODULE it reads the ID and sends the information to controller. The controller receives the information and performs action programmed by us.

**Step1:** Establishing a mode of communication. EM-18 can provide output through two communication interface. One is RS232 and another is WEIGAND. The form of communication is selected by SEL pin. If SEL pin is selected HIGH then form of communication is RS232 and if SEL pin is pulled LOW then form of communication is WEIGAND. Usually the RS232 is selected because it's popular so SEL pin is pulled HIGH.

**Step2:** The output of MODULE bit rate is 9600bps (bit per second). The controller should be programmed to receive information from MODULE at this rate. If bit rate of controller mismatches then the system will not work correctly.

Now let us consider a **simple EM-18 circuit diagram**,



- In the circuit BUZZER is not compulsory. When a TAG is read the BUZZER turns ON. As given in circuit, TX is given to CONTROLLER which is to receive DATA.
- Consider a TAG is brought near the MODULE. The MODULE reads the ID and sends the information to controller in 12 ASCII CHARACTERS. In them, 10CHARACTERS represent the TAG ID and 2 CHARACTERS are XOR of previous 10 CHARACTERS.
- So DATA sent = 10ASCII DATA (tag no.) + 2ASCII DATA (XOR result)
- Once the Information is sent, the MODULES stop sending DATA. This serial DATA received by the controller through RX pin contains TAG information which is ready for processing. We can program the controller to save the DATA or process it to provide response immediately.

## **Applications**

- Robotics
- Security systems
- Medical tags
- Computer Peripherals
- Package Identification
- Theft protection systems
- Data authorization
- Unique Identity
- Body implants

## **Solenoid Lock**

This DC 24V Cabinet Door Lock Electric Lock Assembly Solenoid can be used for locking sell-machine, storage shelf, file cabinet and etc. The hidden way of unlocking can be used for an emergency. The lock works as the circuits disconnects, and it will unlock as the instant power-on. It is steady, durable and energy-saving and had a long lifespan. In the anti-theft and shockproof design, the lock is better than other kinds of locks. After connecting the wires and when the current is available, the electric lock can control the door's opening and closing.



**Fig: Solenoid lock**

- **Features:**

- Iron Body Material
- High quality ultra-compact electric lock.
- Rustproof, durable, safe, convenient to use.
- Suction which tightly sucks the iron, thus locking the door.
- Applicable for being installed in the escape door or fire door electronic controlled system.
- Adopts the principle of electric magnetism, when the current through the silicon, the electromagnetic lock will achieve a strong.

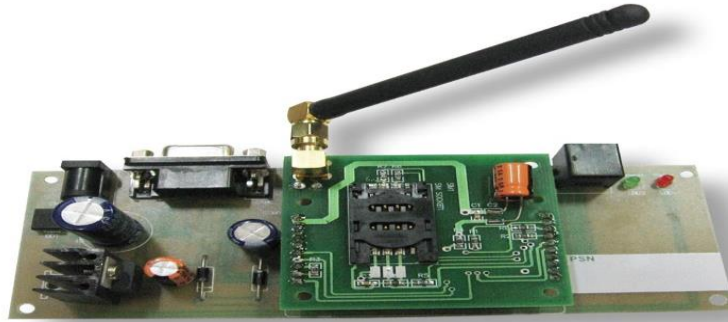
## **GSM**

- **Global System for Mobile Communication (GSM)**

- **Definition:**

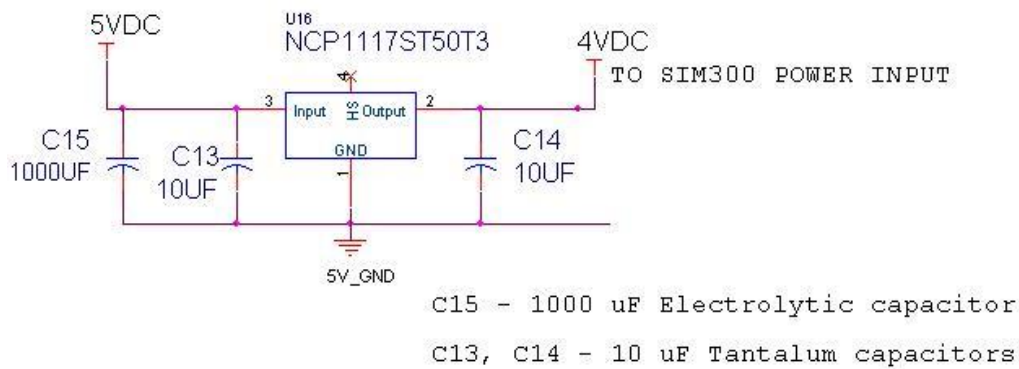
- GSM, which stands for Global System for Mobile communications, reigns (important) as the world's most widely used cell phone technology. Cell phones use a cell phone service carrier's GSM network by searching for cell phone towers in the nearby area. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication.
- GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-

European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership.

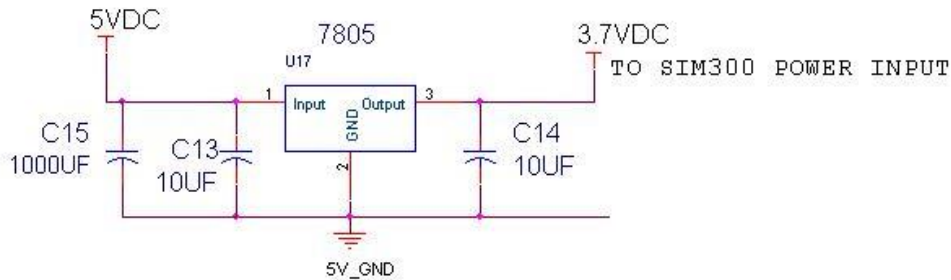


- 
- **INTRODUCTION**
- SIM 300 is a GSM modem with a simple serial interface. SIM 300 modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. With this module one can send/receive sms, connect to internet via GPRS and receive calls. The modem can either be connected to PC serial port directly or to any microcontroller. When purchasing purchase the entire board. As it comes with RS232 to TTL converter and ethernet port Also do check the module by calling a few times when in the shop.
- SIM300 GSM modem works for supply voltages from 3.4V to 4.5V. This voltage is difficult to generate as we dont get a standard regulator at this voltage. Do not give 5V directly to the modem as it is above its absolute maximum ratings .
- Here is a simple circuit which we can build using standard 5V regulators which are easily available. I use these circuits regularly in my projects as they are easy and require less external components to function and no design work. The 5V regulators are given a input of 5V which reduce the voltage to around 3.6 to 4V (due their own internal dropout voltages) which is the required voltage for the SIM300 modem . The 1000uF electrolytic capacitor is very necessary as it gives stability to the GSM MODEM power supply when it consumes large currents during Calling or sending SMS. If the capacitor is not added and your 5V power supply is not capable of delivering required currents during Call and sending SMS then the modem will keep getting reset . I recommend using a 5V 2A power adaptor for the 5V input.
-

#### STANDARD 5V POWER SUPPLY



#### STANDARD 5V POWER SUPPLY



## SOFTWARE DESCRIPTION

### Arduino IDE Compiler:

This instruct-able adds to any of the Arduino on a Breadboard instruct-able.

We need a micro controller with a pre-loaded boot loader, or must load your own Not all ATmega328's are equal

(A boot loader, very simply, is a programme that sits on the chip and manages the upload of your sketches onto the chip)

## PROCEDURAL STEPS FOR COMPILATION, SIMULATION & DUMPING:

### COMPILATION & SIMULATION STEPS:

#### STEP 1: PARTS

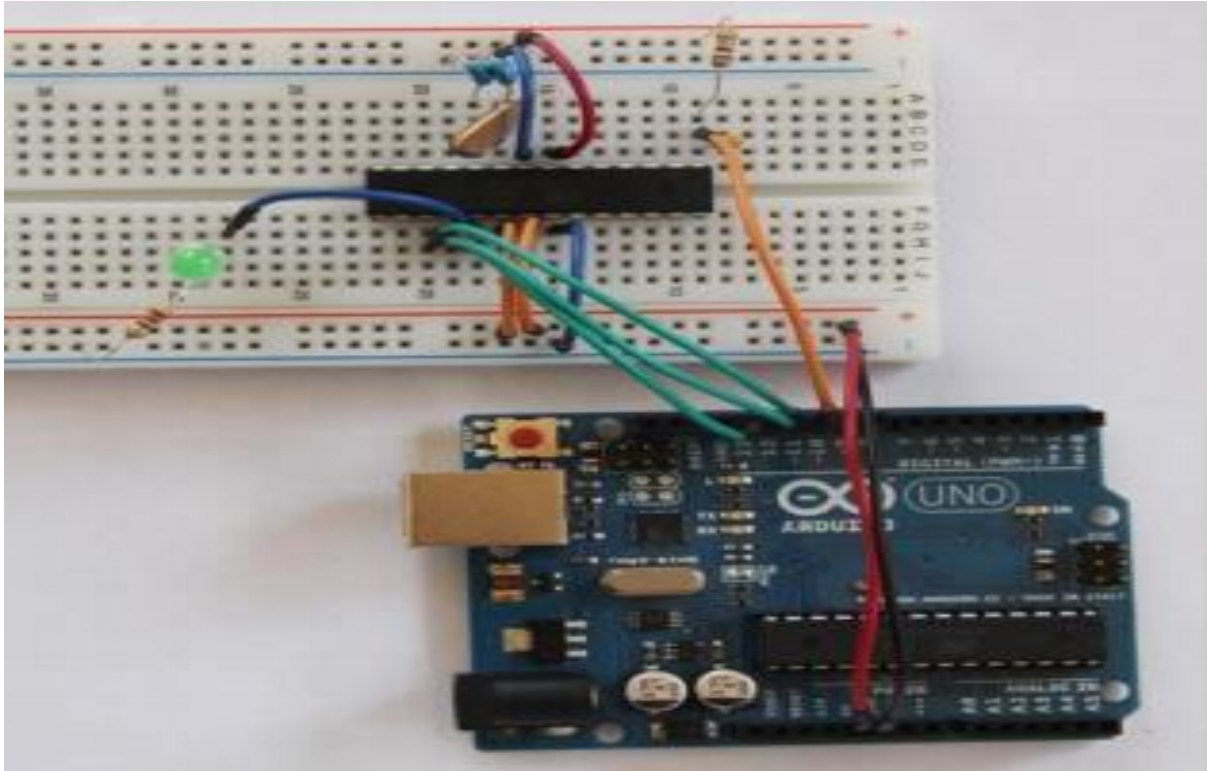
1 x Arduino on a Breadboard

1 x Arduino UNO

Connecting Wires

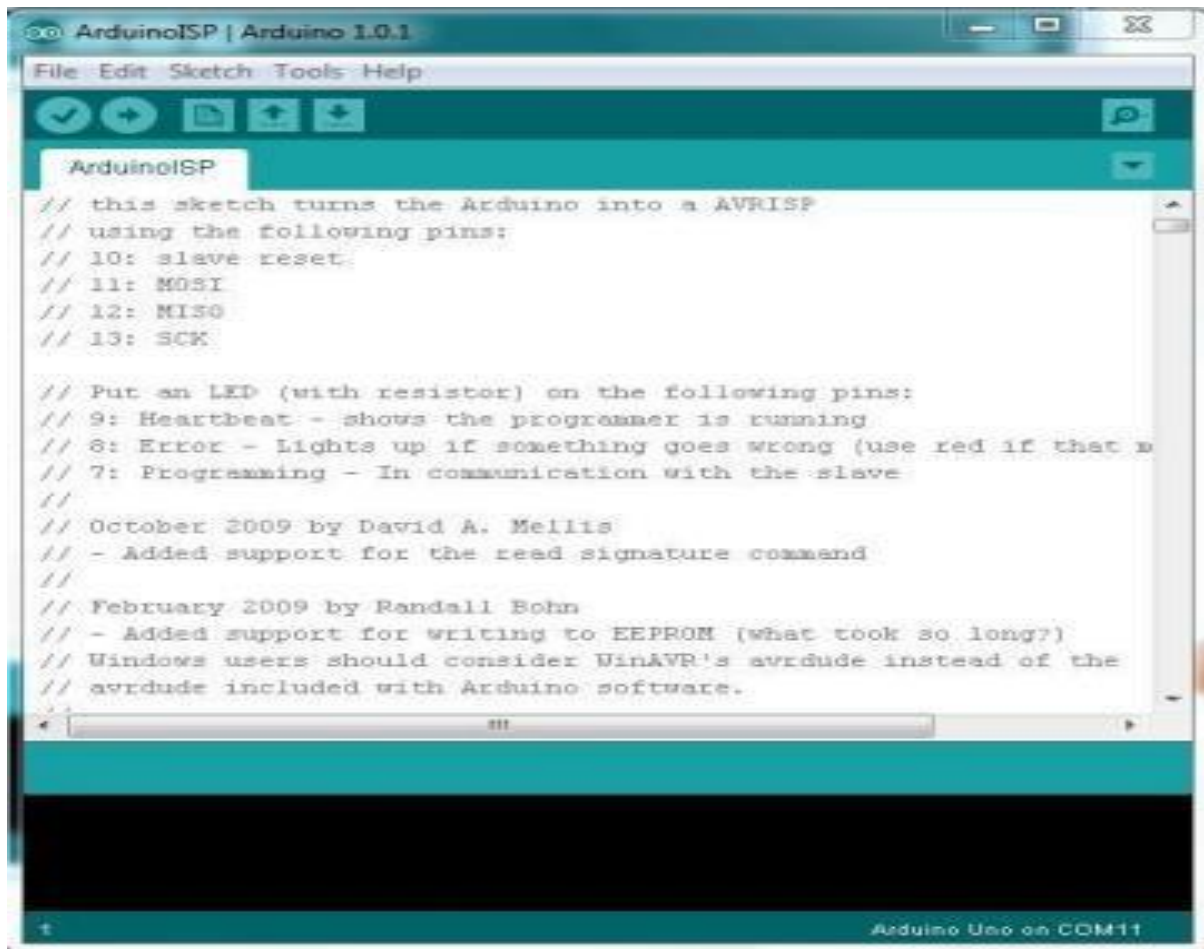
Arduino IDE installed on your PC

## **STEP 2: THE APPROACH**



We use the Arduino UNO to boot-load the ATmega328 that is sitting on the Arduino-on-a-Breadboard. This is fairly straightforward having an ATmega328P-PU, but needs an extra step for an ATmega328-PU.

## **STEP 3: PROGRAM YOUR ARDUINO UNO AS AN ISP**



We need to program the Arduino UNO to act as an ISP (In-System Programmer), so that it can burn the bootloader onto the Breadboard chip.

1. Open the Arduino IDE
2. Open the Arduino ISP sketch (under File, Examples)
3. If you're using version 1.0 of the IDE:

Search for void heartbeat and change the line that reads:

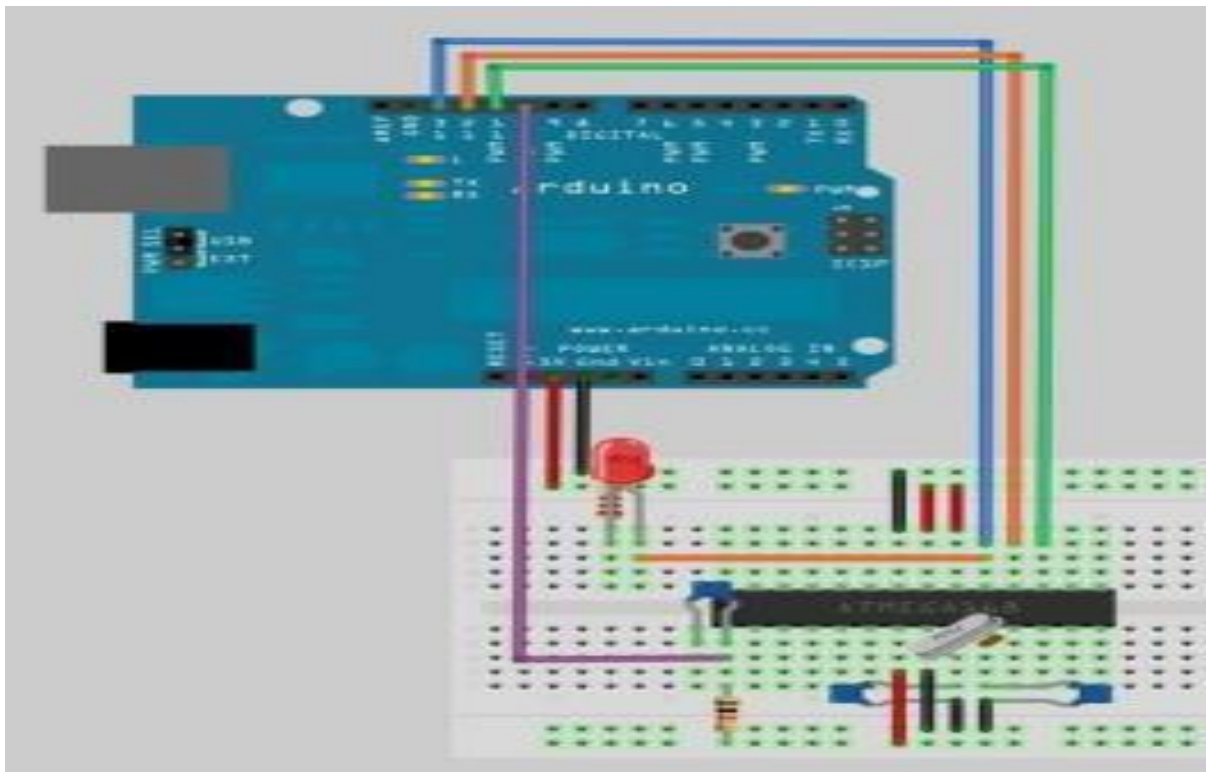
delay (40);

to

delay (20);

Connect your UNO to the PC, making sure it's not connected to the Arduino on a Breadboard. Ensure your UNO is selected under the Boards menu option, and upload the sketch.

#### STEP 4: CONNECT YOUR ATmega328



Now connect your ATmega to your UNO as follows:

- UNO 5v ---> ATmega pin 7 (VCC)
- UNO GND ---> ATmega pin 8 (GND)
- UNO pin 10 ---> ATmega pin 1 (RESET)
- UNO pin 11 ---> ATmega pin 17 (MOSI)
- UNO pin 12 ---> ATmega pin 18 (MISO)
- UNO pin 13 ---> ATmega pin 19 (SCK)

(PCINT14/RESET) PC6	1	28	PC5 (ADC5/SCL/PCINT13)
(PCINT16/RXD) PD0	2	27	PC4 (ADC4/SDA/PCINT12)
(PCINT17/TXD) PD1	3	26	PC3 (ADC3/PCINT11)
(PCINT18/INT0) PD2	4	25	PC2 (ADC2/PCINT10)
(PCINT19/OC2B/INT1) PD3	5	24	PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4	6	23	PC0 (ADC0/PCINT8)
VCC	7	22	GND
GND	8	21	AREF
(PCINT6/XTAL1/TOSC1) PB6	9	20	AVCC
(PCINT7/XTAL2/TOSC2) PB7	10	19	PB5 (SCK/PCINT5)
(PCINT21/OC0B/T1) PD5	11	18	PB4 (MISO/PCINT4)
(PCINT22/OC0A/AIN0) PD6	12	17	PB3 (MOSI/OC2A/PCINT3)
(PCINT23/AIN1) PD7	13	16	PB2 ( $\overline{SS}$ /OC1B/PCINT2)
(PCINT0/CLKO/ICP1) PB0	14	15	PB1 (OC1A/PCINT1)

## STEP 5: WHICH ATmega328 ARE YOU USING?



I learnt the hard way that there is more than one type of ATmega328. The two variants that are of interest to us are the ATmega328-PU and the ATmega328P-PU. The **-PU** suffix means that the chips are in a PDIP package, the format we need for our breadboard.

The **328P** is a pico power processor, designed for low power consumption, and is used on the Arduino boards. Given low power consumption this is first choice. The **328** does not have pico Power technology, and is not used on the Arduino boards – and is not explicitly supported by the Arduino IDE. What this means is that we can easily boot load the ATmega328P, but not the ATmega328. Unfortunately the websites that sell these chips don't always differentiate between them and forums are filled with people struggling to use the ATmega328-PU. Luckily there is a workaround - take a look at my Crash Bang website.

## STEP 6: ATmega328-PU WORK AROUND

Each microprocessor has a *signature* – a unique code that identifies its model. When you boot load a chip (or even upload a sketch) the Arduino IDE checks that the chip selected matches the type it's connected to. Even though the ATmega328-PU in essence functions in the same

way as the ATmega328P-PU, it has a different signature, and one that isn't recognised by the Arduino IDE.



In your Arduino folder, find the subfolder:..**hardware\tools\avr\etc**

1. Make a backup copy of the file: **avrdude.conf**
2. Open the file **avrdude.conf** in a text editor
3. Search for: "**0x1e 0x95 0x0F**" (this is the ATmega328P signature)
4. Replace it with: "**0x1e 0x95 0x14**" (this is the ATmega328 signature)
5. Save the file
6. Restart the Arduino IDE
7. Continue with the rest of the steps in the instruct-able, and once boot loading is complete restore the backup copy you made.

## **STEP 7: BOOTLOAD THE ATmega328**

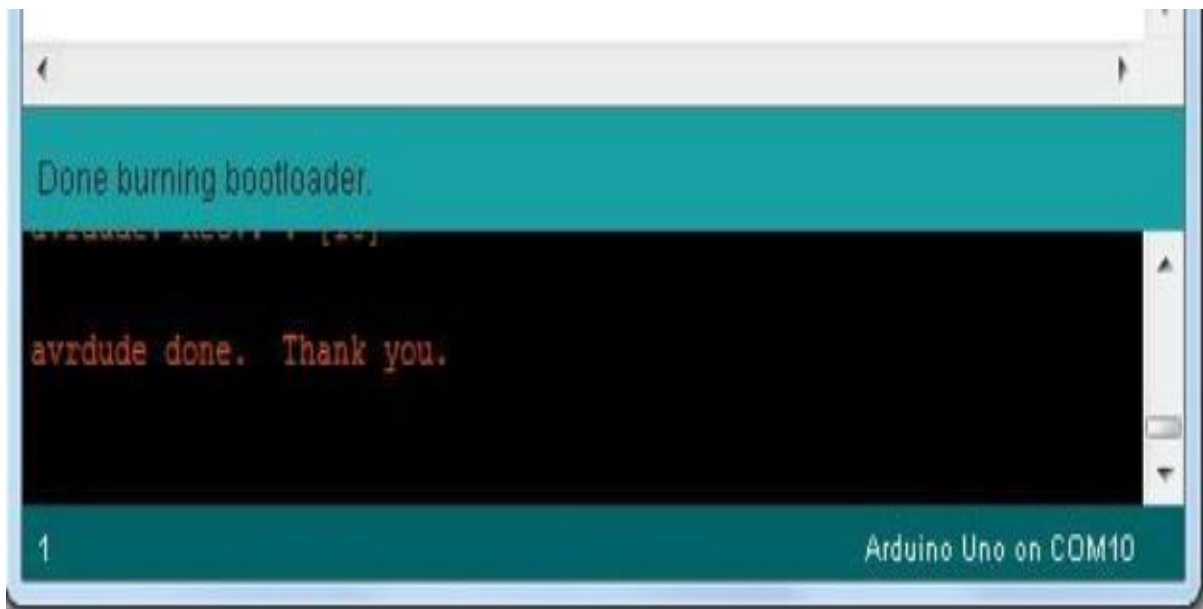
In the Arduino IDE, from the **Tools** menu:

- under the **Board** option choose **Arduino UNO**
- under the **Serial Port** option ensure the correct port is selected



- under the **Programmer** option choose **Arduino as ISP**

To burn the Bootloader, choose **Burn Bootloader** from the **Tools** menu. You should see a message “**Burning bootloader to I/O Board (this may take a minute)**”. Once the bootloader has been burned, a message of confirming the success gets displayed. “**Congratulations: You're now ready to load sketches onto your Arduino on a breadboard!**”



## 6.2 SAMPLE CODE

```
#include <stdio.h>
#include <string.h>
#include <SoftwareSerial.h>

SoftwareSerial mySerial (8, 9); // RX, TX


char ch;
int led = 13;
int relay = 10;

int count = 0;

char *c1="160052EE72D8";

void setup()
{
    mySerial.begin(9600);

    Serial.begin(9600);

    pinMode(led,OUTPUT);
    pinMode(relay,OUTPUT);

    digitalWrite(led,1);
    delay(700);
    digitalWrite(led,0);
    delay(700);
    digitalWrite(led,1);
    delay(700);
    digitalWrite(led,0);
}

void loop()
{

    String ddata = "";
    int flag = 0;

    while(1)
    {

        count = 0;
        delay(160);
        if (Serial.available() > 0)
        {
```

```

i = 0;
while(1)
{
    char inChar = Serial.read();

    if(strcmp(inChar, c1) == 0)
    {
        digitalWrite(13, LOW); // turn the LED on (HIGH is the voltage level)
        digitalWrite(relay, HIGH); // turn the LED on (HIGH is the voltage level)

        mySerial.println("AT+CMGF=1");
        delay(200);
        mySerial.println("AT+CMGS=\"+919100326021\"");
        delay(300);
        mySerial.println("**** Authorised ****");
        delay(200);
        delay(3000);

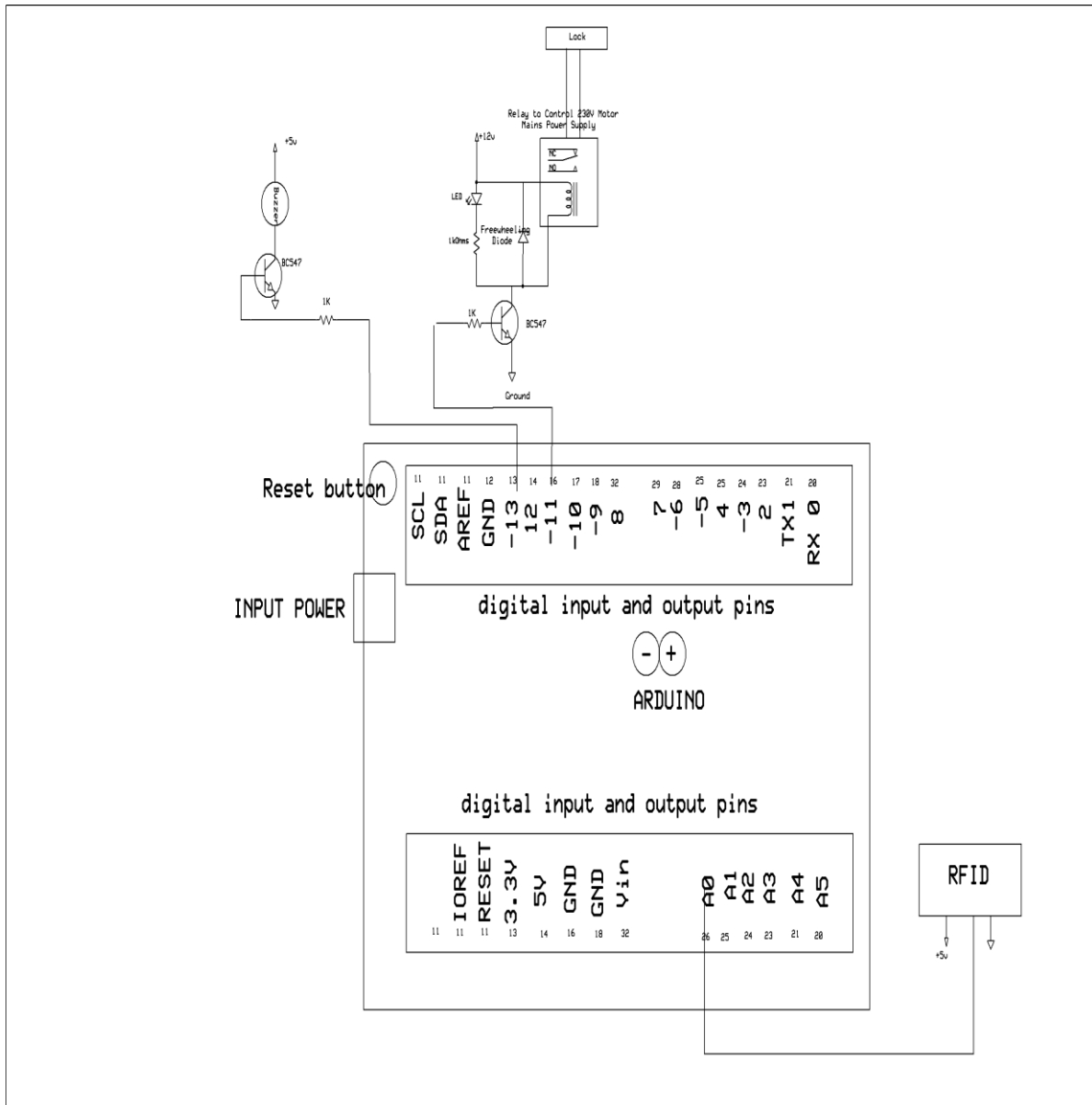
        digitalWrite(relay, LOW); // turn the LED on (HIGH is the voltage level)
        break;
    }
    else
    {
        digitalWrite(13, HIGH); // turn the LED on (HIGH is the voltage level)

        mySerial.println("AT+CMGF=1");
        delay(200);
        mySerial.println("AT+CMGS=\"+919100326021\"");
        delay(300);
        mySerial.println("****ALERT**** Un-Authorised ");
        delay(200);
        digitalWrite(13, LOW); // turn the LED on (HIGH is the voltage level)
        break;
    }
}
}
}
}
}
}
}
}

```

## 7.SYSTEM TESTING

### 7.1 CIRCUIT DIAGRAM



**Fig 21: Schematic diagram of RFID Smart Door Lock Using Arduino**

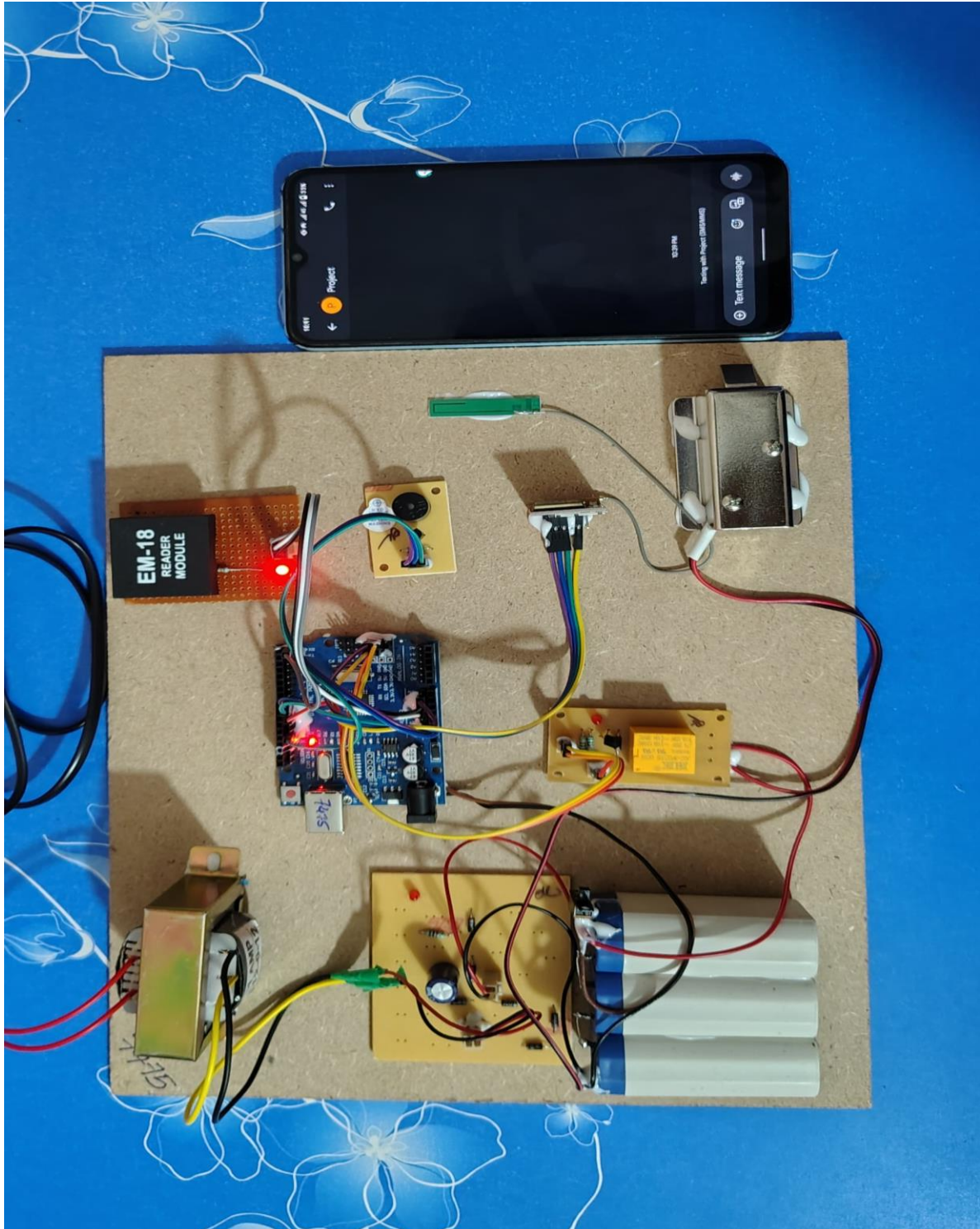
The above schematic diagram of **RFID Smart Door Lock Using Arduino** explains the interfacing section of each component with micro controller, RFID reader and tags, LOCK and Buzzer.

## 7.2 TESTING & TEST CASES

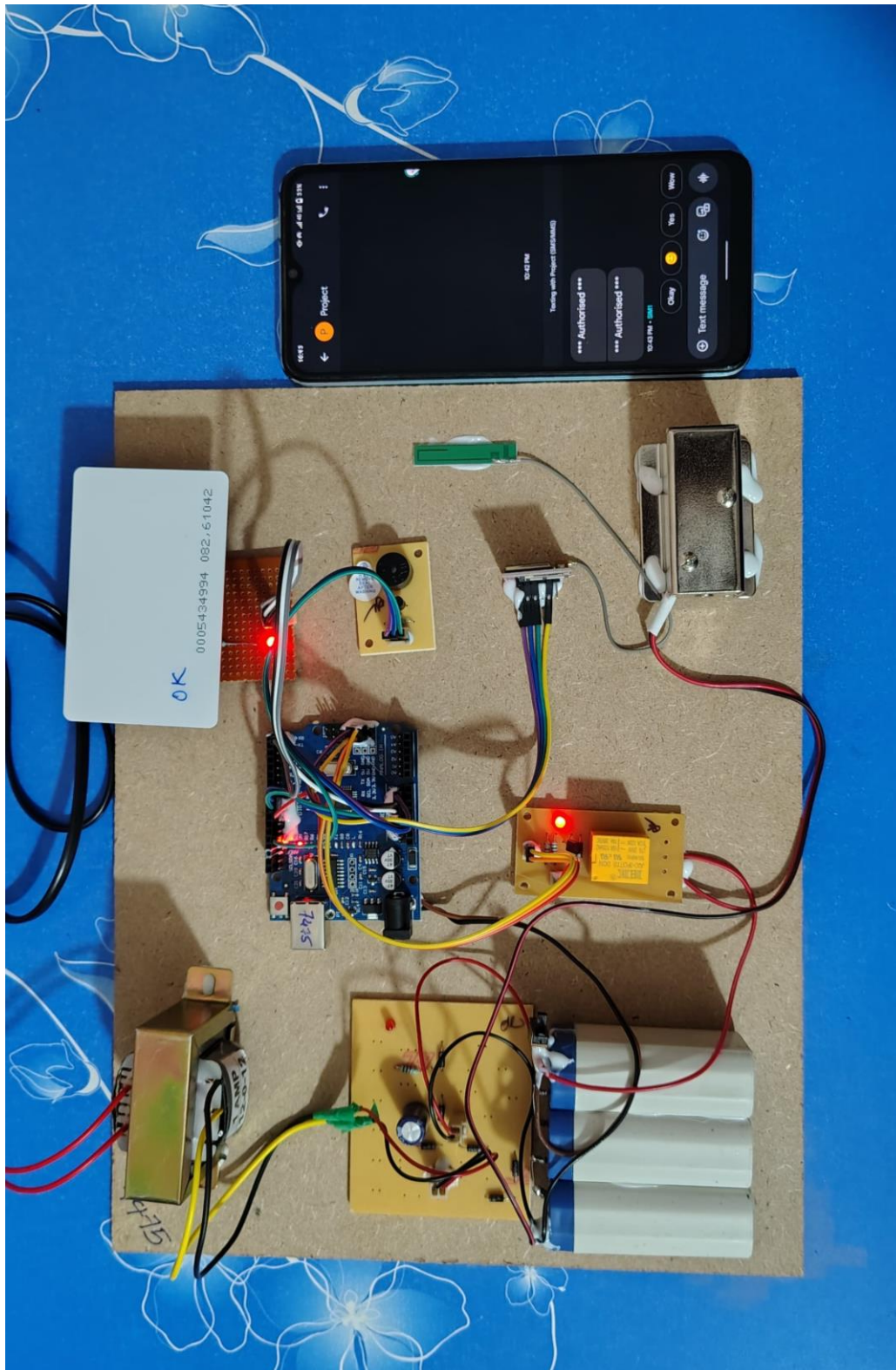
S.NO	TEST CASES	TESTCASE DESCRIPTION	EXPECTED OUTPUT	OBTAINED OUTPUT	TEST RESULT
1.	Relay Switch On	Using an Authorized card tap on Reader	Give Access	Access Granted	Pass
2	Relay Switch Off	Using an Authorized card tap on Reader	No Access	Access Denied	Pass
3	Buzzer	If unauthorize card is Tap on Reader	Activate Buzzer	Buzzer Activates	Pass
4	Buzzer	If authorize card is Tap on Reader	No Buzzer	Buzzer not Activated	Pass
5	RFID-Reader	Tap on reader	Read Card	Card Readed	Pass

## 8. OUTPUT SCREENS

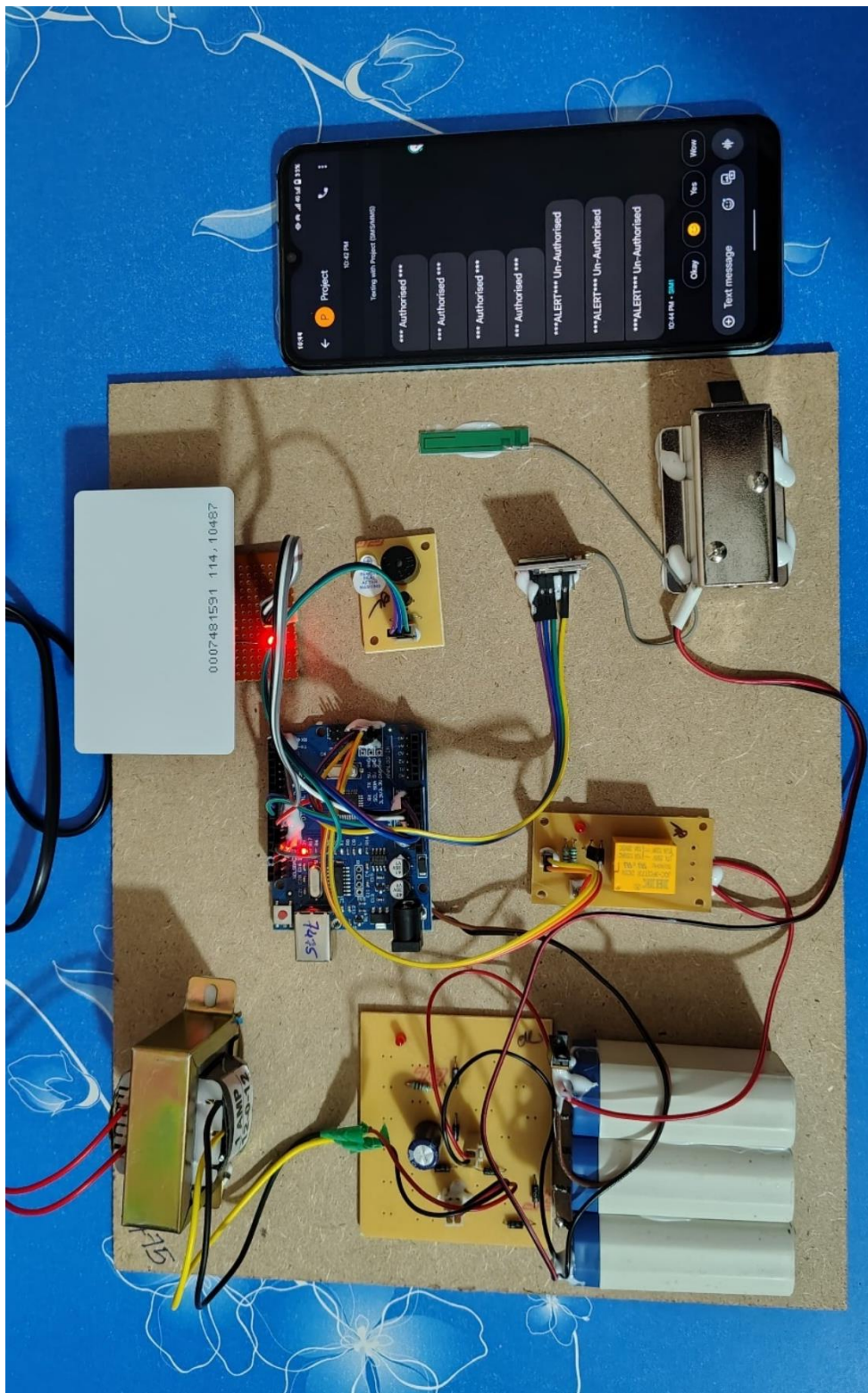
1.Power supply ON, Led Blinks and System initializes.



## 2. Using an Authorized card tap on Reader



### 3. Using an Unauthorized card tap on Reader



## 9. CONCLUSION

In conclusion, the **Electronic Door Lock System using RFID and Arduino** provides an efficient, secure, and cost-effective solution for access control. By integrating **RFID technology** with the **Arduino microcontroller**, the system ensures that only authorized users can access a restricted area through RFID tag validation. The use of additional components like a **relay-controlled solenoid lock**, **buzzer for feedback**, and an optional **GSM module** for remote alerts enhances the system's reliability and functionality. The design is scalable, energy-efficient, and easy to modify, making it suitable for **homes, offices, laboratories**, and other secure environments. Overall, this project demonstrates how embedded systems and automation can significantly improve traditional security systems, laying a strong foundation for further innovations such as **IoT-based door locks** and **multi-factor authentication**. Integrating features of all the hardware components used have been developed in it. The presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, the project has been successfully implemented using highly advanced ICs with the help of growing technology. Thus, the project has been successfully designed and tested.

## 10.FUTURE SCOPE

### 1. Integration with IoT (Internet of Things)

- Connect the system to the internet for **remote monitoring and control**.
  - Use mobile apps or web dashboards to lock/unlock the door remotely.
  - Real-time access logs accessible from anywhere.
- 

### 2. Multi-Factor Authentication

- Combine RFID with **keypad password, biometric scanner (fingerprint/face), or OTP via SMS** for improved security.
- Ensures secure access even if an RFID tag is lost or cloned.

## 11.REFERENCE

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