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## CS5068NI– Cloud Computing & IoT

## Home Automation Using IOT

## Assessment Type

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## Semester

## 2024 Spring

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## Acknowledgement

First, we would like to thank for the support, guide and encouragement throughout the development of our IoT project by our class tutor Mr. Jaganath Paudyal and our module leader Mr. Sugat Man Shakya. Their expertise and guidance have given us the direction in creating success of our home automation system.

We also want to thank all those who have provided us feedback and suggestions for the improvement of some or many parts of our project. Some of their input has been greatly appreciated.

## Abstract

Technology today has become an important part of simplifying daily life. With the gross increase of convenience and efficiency, home automation has come into the picture, providing a great way to manage routine household tasks more easily. This project concludes in a Home Automation System that includes basic automation features such as door unlocking through an RFID sensor and automated water pumping using an ultrasonic sensor. These systems work through sensor-based controls without relying on Wi-Fi or mobile applications. The system is designed to be user-friendly and accessible to the general population, particularly children, the elderly, and differently abled individuals, through easy operation, added security, and a more peaceful living experience. With its sensor-based functionality, this project demonstrates how IoT technologies can help transform traditional homes into smarter, more responsive environments that enhance the quality of everyday life.

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# 1. Introduction

The Internet of Things (IoT) is programming the new way of communicating with every physical system at their existence, simply be allowing real time control and monitoring of said physical structures through connected devices. Integrated IoT Project is formed to enhance the daily living with the embedded technologies like micro controller, sensors and communication network to collaborate as a system (Grand View Research, 2025). Smart home automation is one area where it will be used, allowing homeowners to control such things as lighting, security remotely through their smartphones or other smart devices.

The focus of this project is to achieve an easy and secure system for the use of common challenges involving households using an intuitive and user friendly applications called "Home Automation Using IOT". The idea of the project is targeted to enhance the daily convenience of life, especially for the housebound and differently abled, through minimizing human errors like forgetting to lock doors or control usage of water. RFID and ultrasonic sensors utilize automated tasks such as door locking and water pump control with a view of eliminating wastage of water as well as increasing security levels in the household. This not only efficiency of resource use but also safer and dependable environment for all user.

## 1.1. Current scenario

Most households still carry out various household tasks such as locking doors and operating water pumps in a manual way. This can be especially a bother when the resident is not around, busy or forgetful, leading to wastage of water or issues of security. These are worse for older people, those who are differently abled, or house-bound. With the increasing vogue of smart and assistive home systems, automation solutions such as RFSD-based door locks and sensor-controlled water pumps become more to the point. Such systems are focused on betterment of everyday convenience, efficient use of resources and greater safety without the need of complex technologies such as mobile apps or internet connectivity.

## 1.2. Problem Statement and Project as a solution

Due to the busy schedule of modern lifestyle and growing reliance on technology, some basic and mundane tasks like locking doors or maintenance of water supply are largely forgotten, causing water wastage and insecurity risk. These struggles are actually greater for differently-abled individuals, aged people or housebound ones who might have problems executing such tasks manually. This project proposes the practical solution with automatic door locking system through RFID technology and water pump operation on the basis of the water level using ultrasonic sensor. The aim of the system is to be basic, widespread, and effective in improving the state of household security and water conservation.

## 1.3. Aim and Objectives

The main aim of this project is to build a smart home system to automate door locking using RFID and water pump control based on ultrasonic sensor – for improved security, convenience, and conservation of water.

**Objectives**

- To develop and gather knowledge on home automation and smart living
- To automate the door locking system using RFID for improved home security.
- To prevent water wastage by automating water pump system to pump when needed.
- To create an easy-to-use solution for differently abled individuals in order to ease the process of home management for them.

# 2. Background

## 2.1. System Overview

The proposed IoT-based home automation system is for the automation of the door locks operation which uses an RFID sensor and the operation of water pump by using an ultrasonic sensor. This project aims at minimizing human effort, increasing security and conserving water. It is particularly beneficial to busy people or persons with disabilities who have an accessible and convenient way of accessing vital home functions.

To make this project, various components are used. The main controller is an Arduino which connects with a relay module, ultrasonic sensor and a breadboard. The relay module is used for switching the devices like solenoid lock and water pumps on or off, the ultrasonic sensor measure the distance or water level in the tank. Resistor helps to control the flow of electric current and jumper wires are used to connect various components.

The system is constructed to automatically control the door lock with the use of RFID sensor and water pump control with ultrasonic sensors. This makes the home safer, saves energy and makes it easy to manage and control. This project shows how smart home automation can improve our daily life with simple and affordable solutions.

## 2.2. Design Diagrams

In this part, the block diagram of the project is mentioned along with the physical representation of the project.

### 2.2.1 Block Diagram

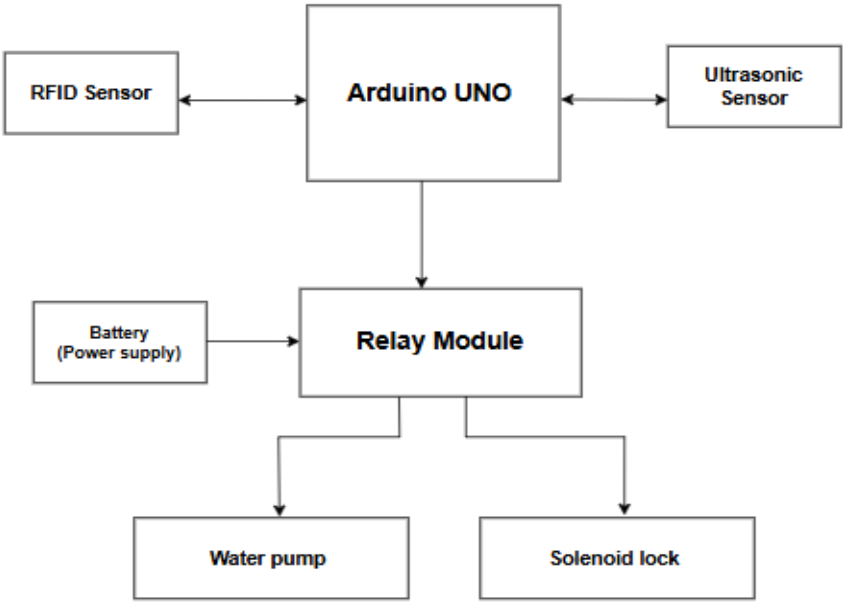


*Figure 1: Block diagram*

### 2.2.2 System Architecture

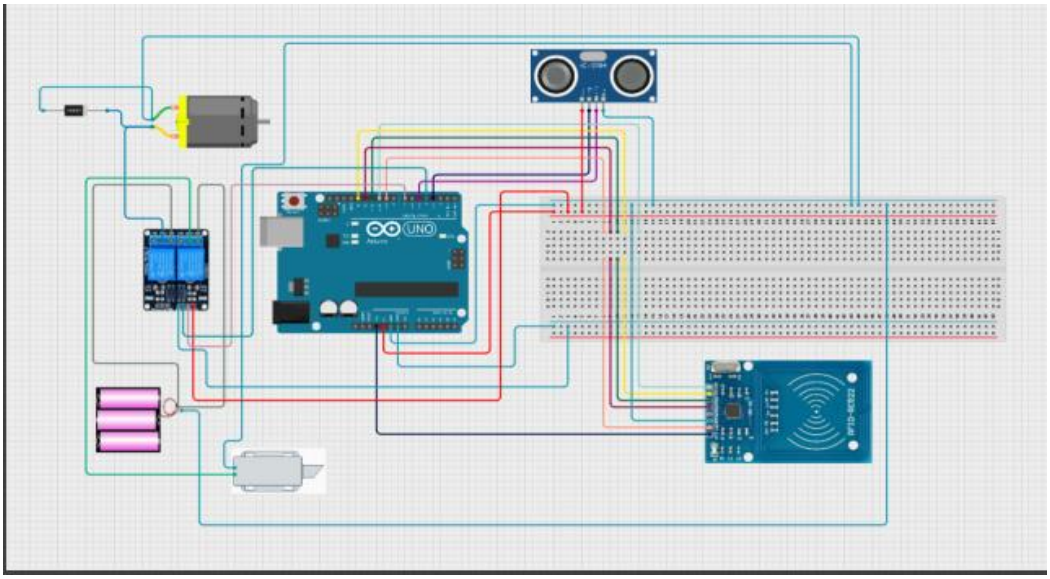

*Figure 2: System Architecture*

## 2.3. Flowchart

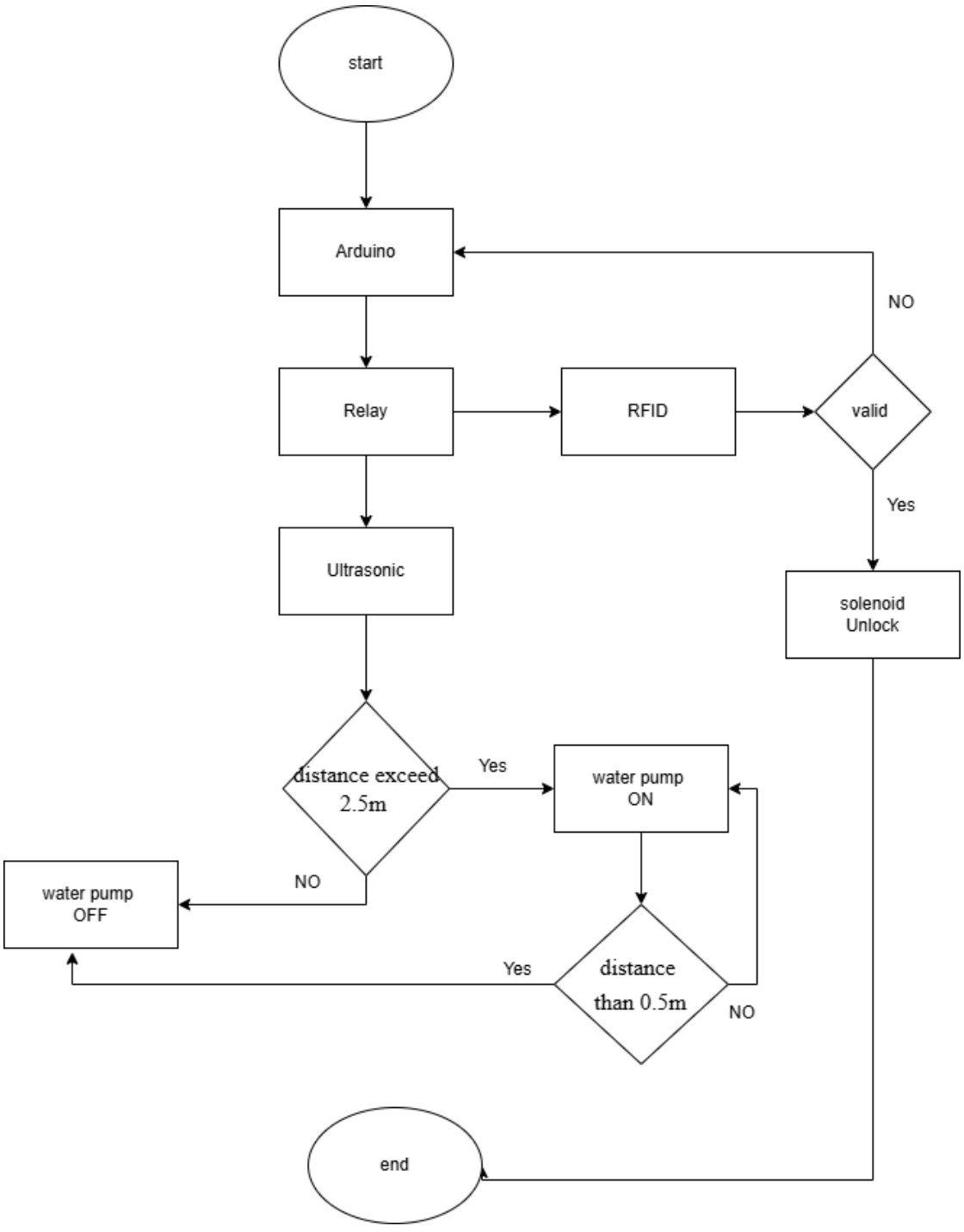


*Figure 3 : Flowchart*

## 2.4. Requirement Analysis

### 2.4.1. Hardware components

- **Arduino UNO**

  Arduino is low-cost, open-source electronics platform based on simple software and hardware. It consists of a microcontroller that can be programmed to control electronic device like sensors, motors and LEDs. It is popular for making projects like home automation, simple robots, and many other IoT devices. It is beginner friendly and widely used because it is very simple and easy to use and strong support from large community. (Rancho Labs, 2023)

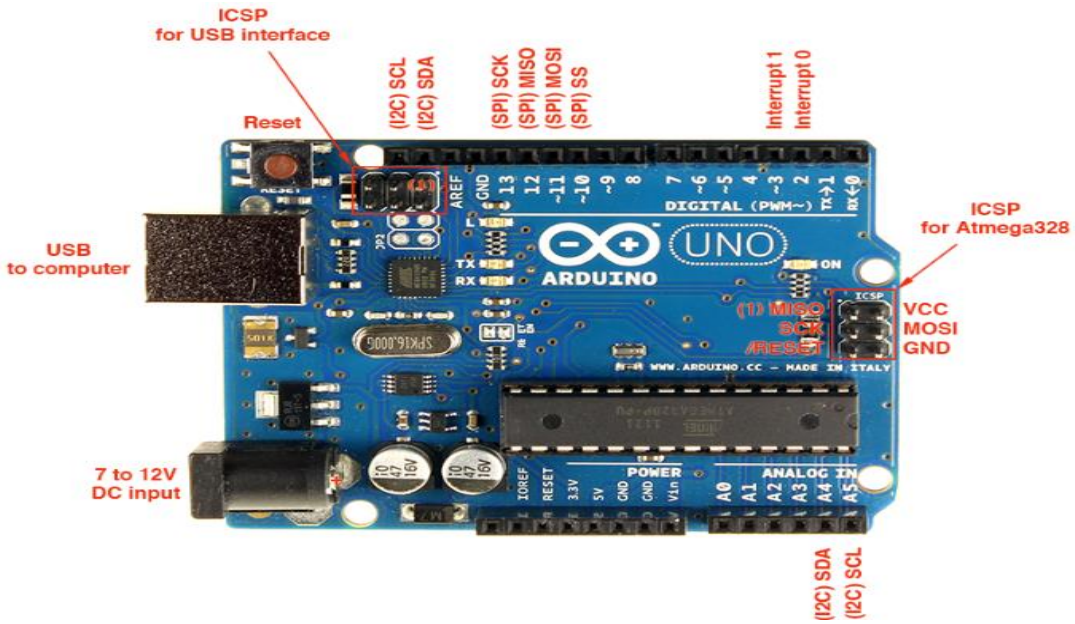


*Figure 4: Arduino Uno (Marian, 2013)*

- **Breadboard**

  Breadboard is a small plastic board that is used to connect electronic parts without soldering or using glue. It has many tiny holes that allows easy insertion of components like LEDs, resistors, sensors and wires. It consists of two main parts, that are terminal strips for connecting components and power rails for supplying voltage. It helps to build and test circuits easily by allowing quick and flexible connections. (Blues University, 2024)

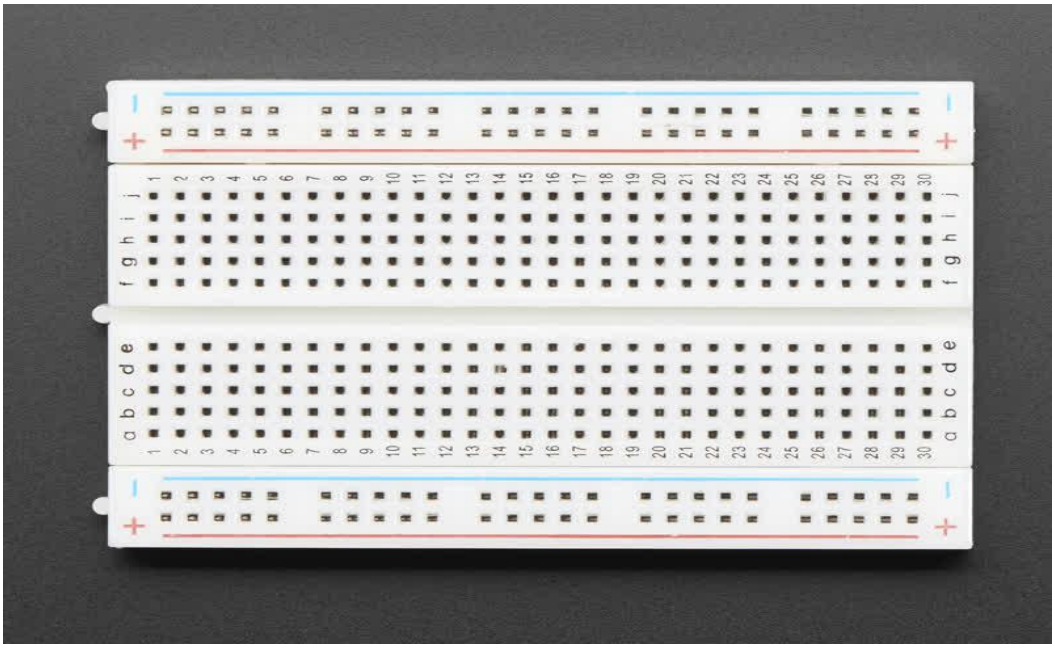

*Figure 5: Breadboard (Elecrow, 2018)*

- **Relay Module**

  A relay module is an electronic switch that control high voltage device with a low voltage signal. It acts like a bridge between low-power and high-power devices. When an Arduino sends a signal, the relay either turns the device on or off (pi_and_chips, 2017). In this project, the relay module controls lights, door locks and water pumps. When a button is clicked on the mobile app, the relay receives the signal from the Arduino and switches the connected device on or off.


*Figure 6: Relay module (Last Minute Engineers, 2025)*

- **Ultrasonic Sensor**

  An ultrasonic sensor is a device that measures the distance by using sound waves. It sends out sound and waits for it to bounce back (MinukaThesathYapa, 2021). The ultrasonic sensor used in our project is classified as an active sensor based on energy conversion, as it emits ultrasonic waves and detects the reflected signal from nearby objects using its own source of energy. Furthermore, it is considered a digital sensor based on the nature of its output signal, as it typically produces a digital pulse output corresponding to the distance between the sensor and the object


*Figure 7: Ultrasonic Sensor (geeksforgeeks, 2024)*

- **LED**

  LED is a small light that glows when electricity passes through it. It is used to show signal, whether a device is on or off.

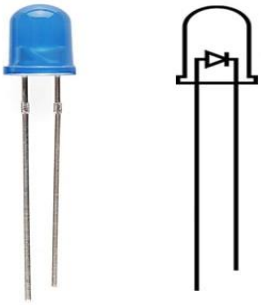

*Figure 8: LED (Hemmings, 2021)*

- **Solenoid lock**

A solenoid lock is an electronic lock. It opens or closes with electricity instead of a key (Magnet-schultz, 2024). When power is applied the lock moves and locks or unlocks the door. In this project, the solenoid lock is used to control the door. Users can open or close the door from their phone using the mobile app. It makes the home safer and easier to manage.

*Figure 9: solenoid lock (Magnet-schultz, 2024)*

- **Resistor**

A resistor is a compact electronic component that regulates the flow of electrical current (Britannica, 2025). It safeguards other components, such as LEDs, from excessive power that could lead to failure. In this project, the resistor is used to manage the electrical supply to the LEDs, ensuring they light safely and effectively.


*Figure 10: Resistor (Goyal, 2021)*

- **DC Motor**

  DC motor is an electronic device that converts electrical energy from a direct current (DC) power source into mechanical energy, typically rotational motion (RS Components, 2023). In this project, DC motor is used in automatic water system.

*Figure 11: DC Motor (Voltaa, 2025)*

- **Jumper Wires**

  Jumper wires are small wires that are used to connect different parts of a circuit. They help to pass electricity between components like Arduino, sensors and LEDs (Hemmings, 2018). In this project, Jumper wires are used to join the Arduino with breadboards, relay module and ultrasonic sensor, so everything works together.

*Figure 12: Jumper Wires (Hemmings, 2018)*

- **Flyback diode**

  Flyback diode is a freewheeling diode connected in parallel with an inductor to prevent voltage spikes when the inductor's current is suddenly interrupted (Altium, 2023). In this home automation, the function of a flyback diode is to protect the circuit by stopping voltage spikes when the motor is turned off which can damage other components in the circuit.

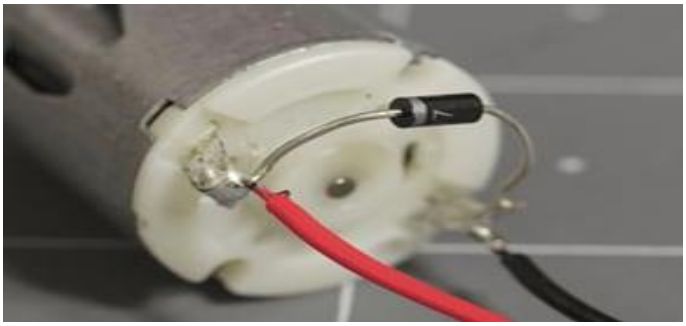

*Figure 13: Flyback diode (Cook, 2021)*

- **RFID (Radio-Frequency Identification)**

  RFID is a wireless technology that uses radio waves to identify and tracks tags attached to objects (Raikar, 2022). In this home automation, the function of the RFID is to allow access to authorize users by unlocking the doors when the valid RFID tag is detected. It is easy to use in automatic door lock it is simple, fast and contactless.


*Figure 14: RFID MF522-Ed (Amazon.in, 2023)*

### 2.4.2. Software components

- **Arduino IDE:** The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board (Söderby, 2024). This software can be used with any Arduino board.
- **Tinker Cad:** Tinker Cad is used to design and test IoT project without real hardware.
- **Draw.io:** Draw.io is used to create circuit diagram and system designs.
- **Microsoft Word:** Microsoft Word is used to write the proposal of the project and to document the project details.

# 3. Development

### Step 1: Design and the planning of project

All the group member gathered together and had different opinions on how any project can be done. And based on cost effectiveness and real-world implementation, we decided to do this project. Additionally, a member in our class was late to attend the class because he forgot to turn off water pump at home and no one was present at home. So, in order to tackle this kind of problem and to make life easier, we came up with the idea of home automation. We initially had a rough sketch of the components needed but we managed to sort out the basic components we may require for the project.

### Step 2: Resource collection

We divided the work load to each member and two of us went to collect the components required. About half of the devices were available at Islington College itself and remaining half had to be bought by ourselves from external source. Additionally, we were also aware about the components we may need as we made progression on the project.

### Step 3: System Development

We started by designing the circuit on tinkercad software. This software contains variety of components we need in the project and also provides simulation feature which we need in case of physical representation of the project. All the requirements such as pin connection, assembling the wire, input of sensor could be monitored in the software which made it a lot easier for us to design the system more effectively and efficiently. Similarly, the code that we needed to write on the Arduino IDE app could be written here and be simulated.

Phase 1: Checking the Arduino and supplying power to breadboard

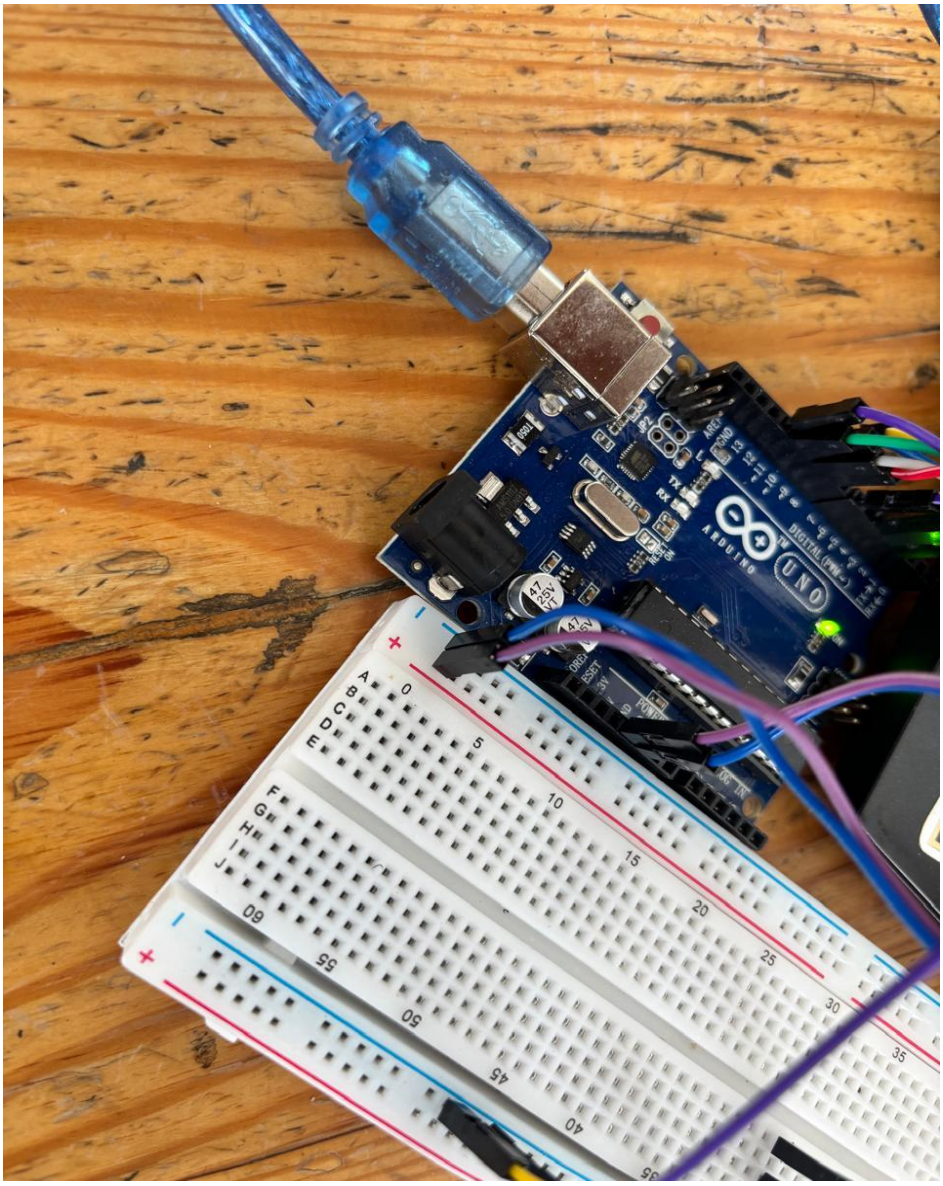

*Figure 15 Checking the Arduino and supplying power to breadboard*

We initially connecte the Arduino to laptop in order to check the working of Arduino. It worked perfectly so the next step Ws to provide the power in bread board in order to secure the connections for the sensors and actuators. For this, we established 5V pin abd GND pin from Arduino into the breadboard.

Phase 2: Connecting the sensors with the Arduino

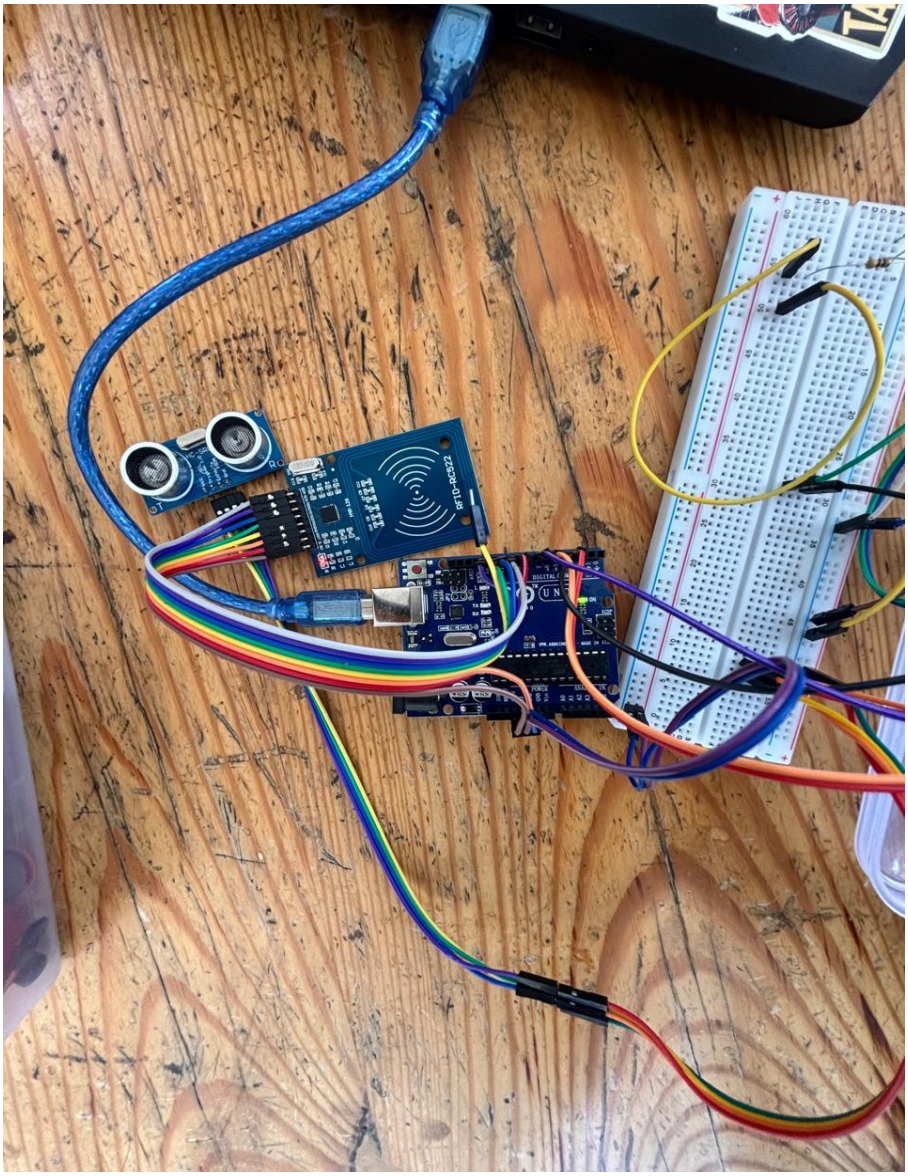

*Figure 16 Connecting the sensors with the Arduino*

The sensors we chose are Ultrasonic sensor and a RFID. The RFID needed SPI connection for which specific pin; D9,D10 and D11 were designated. So we connected the pin to these specified port of Arduino. The RFID needed 3.3V input so the positive terminal was connected to 3.3V and GND was connected to GND of Arduino. For ultrasonic sensor, the trig pin was connected to D3 and the echo pin was connected to D5. The power was given

through +5V and GND on the breadboard. To make the connection easier, the connection was taken through breadboard for the pins.

Phase 3: Connecting Actuators with the Arduino

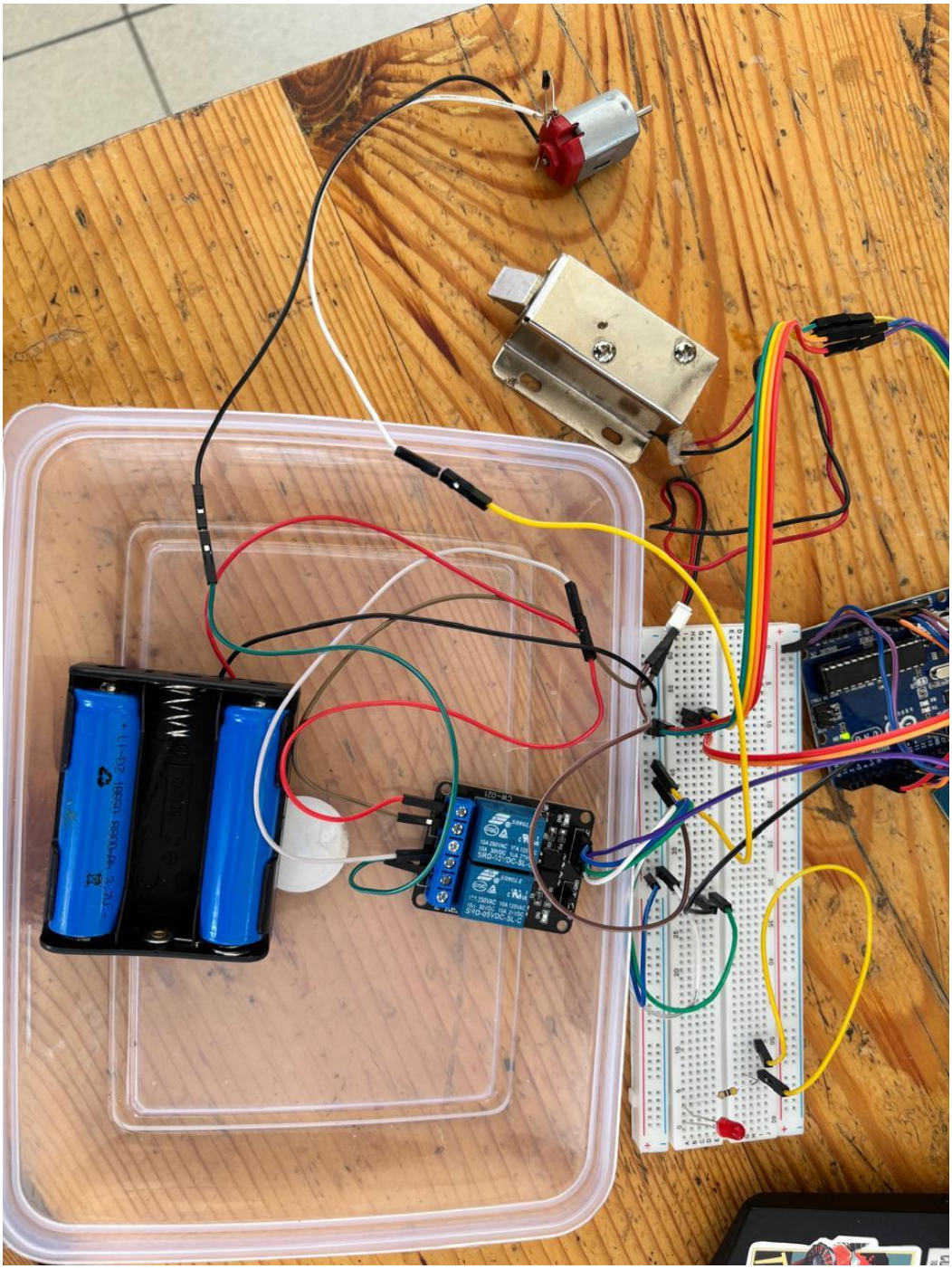

*Figure 17 Connecting Actuators with the Arduino*

For actuators we chose DC motor as a prototype for water pump and a solenoid lock for the door. In order to run the actuators, we needed external power supply which we provided through external batteries. In order to provide required voltage to the actuators, we needed to connect them through a Relay module to the Arduino. The input from sensors provided to Arduino triggered the relay to specific actuator.

**Phase 4: Writing code for the project.**

The code for the project of Arduino was written through Arduino IDE app. We had to extract different libraries for the sensors to word. With proper pin connections and the compilation of code, we could get the result we intended to get.

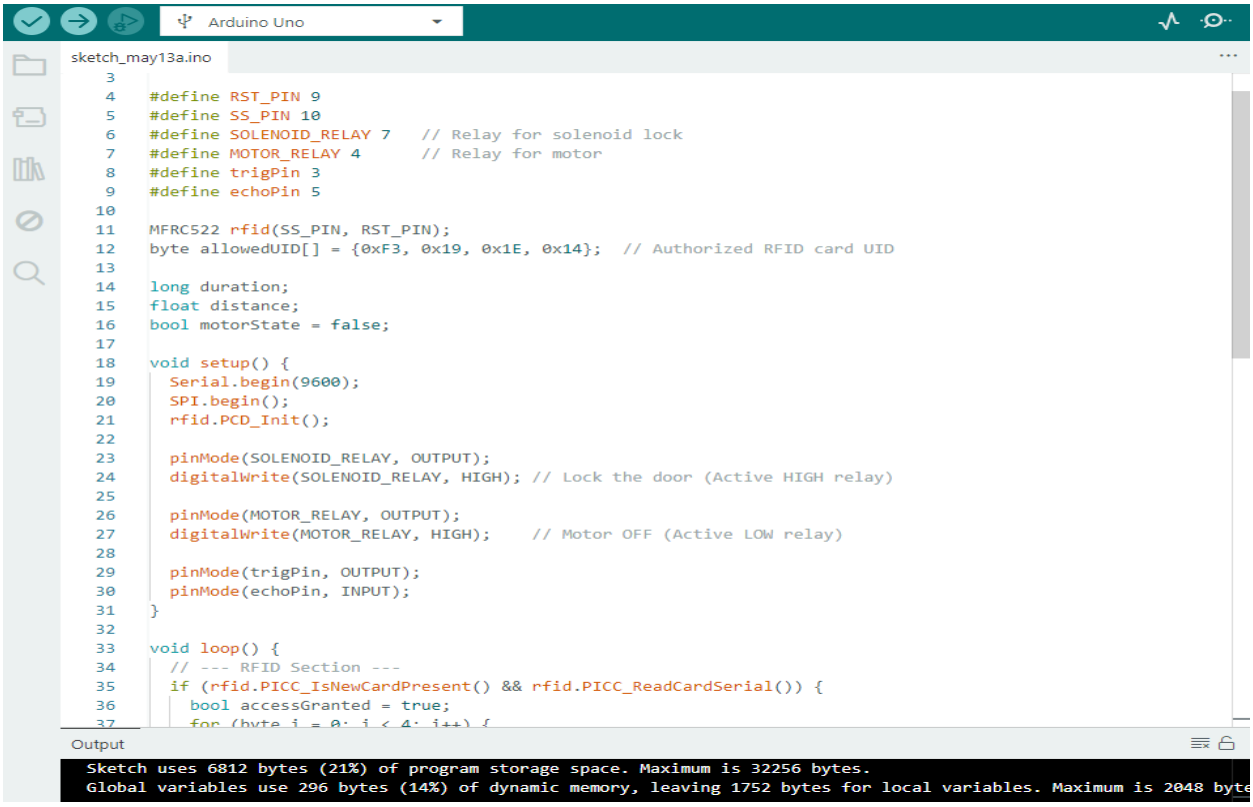


*Figure 18 writing code in Arduino*

**Step 4: Physical connection of the components**

After the connection of the simulation circuit in tinkercad, it was a lot easier to connect the circuit physically. However, the problem arose when the circuit connections were loose and there was a risk of short circuit. In order to solve this problem, the connections were made permanent with the help of soldering rod and the components were fixed using hot glue gun to the breadboard.

# 4. Results and Findings

## 4.1. Result

After completing the project, we successfully constructed a viable prototype of home automation system that has both RFID based solenoid door lock and one that incorporates an ultrasonic sensor that regulates water pump using Arduino. From this project, we saw how simplicity in automation can bring about house hold chores that are safer, efficient and easier to do. The RFID system provided secure and touchless door unlocking, thus eliminating the need for door keys while assuring accessibility to the elderly or the differently abled.

Similarly, the combination of an ultrasonic sensor and the water pump permitted an automatic adjustment dependent on the water levels, eliminating the necessity for regular manual supervision. Such system not only saves time and effort but also helps in conserving water because the pump only comes on when required. Conclusively, this project shed light on how a household can benefit from the low-cost automation concerning convenience and resource management.

## 4.2. Findings

In this section, different test cases are included in order to show the successful working of the project. The test cases are:

### 4.2.1 Test-1

| **Test no.** | **1** |
|---|---|
| Objective | To test the execution of code |
| Action | The code was written, verified and uploaded to the Arduino UNO. |
| Expected result | The code to be compiled and uploaded without any error. |
| Actual Result | The code compiled and was uploaded without any error. |
| Conclusion | Test was successful. |

*Table 1: Test-1*

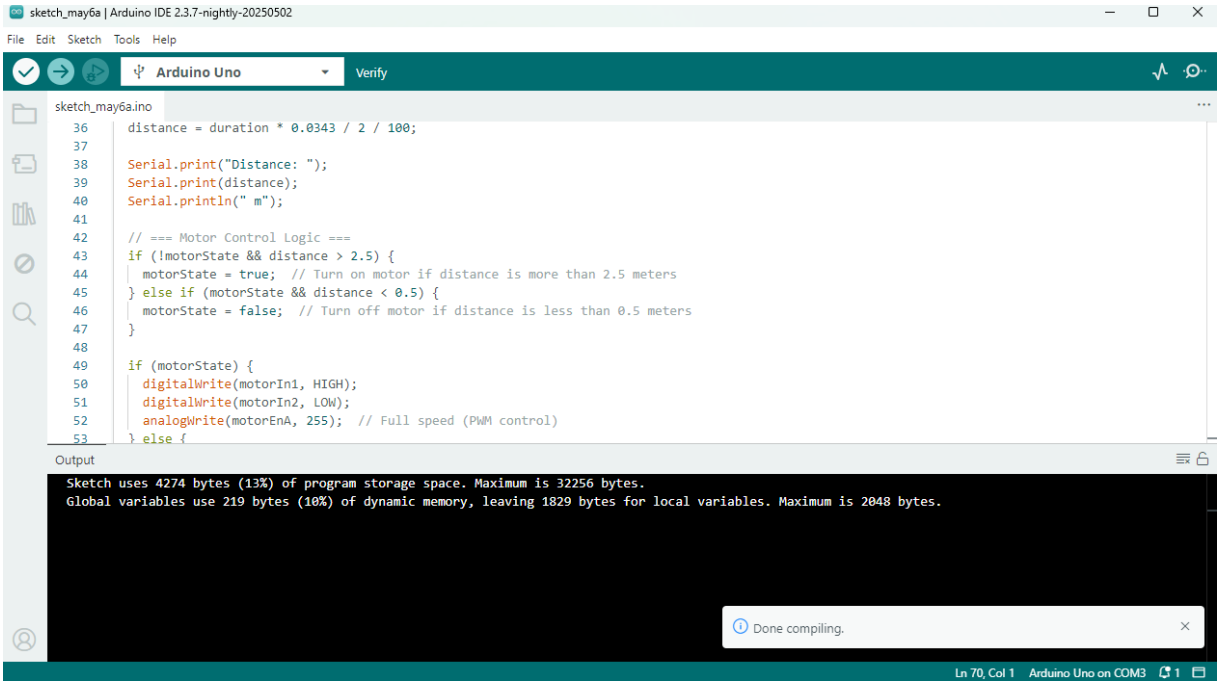


*Figure 19 : Test - 1*

### 4.2.2. Test 2

| **Test no** | **2** |
|---|---|
| Objective | To check working of Ultrasonic sensor |
| Action | Place a obstacle at different distance and check serial monitor and DC motor. |
| Expected Result | The DC motor should be on When distance exceed 2.5m and stop when less than 0.5m. |
| Actual Result | The motor was on and off as required |
| Conclusion | The test was successful. |

*Table 2: Test-2*

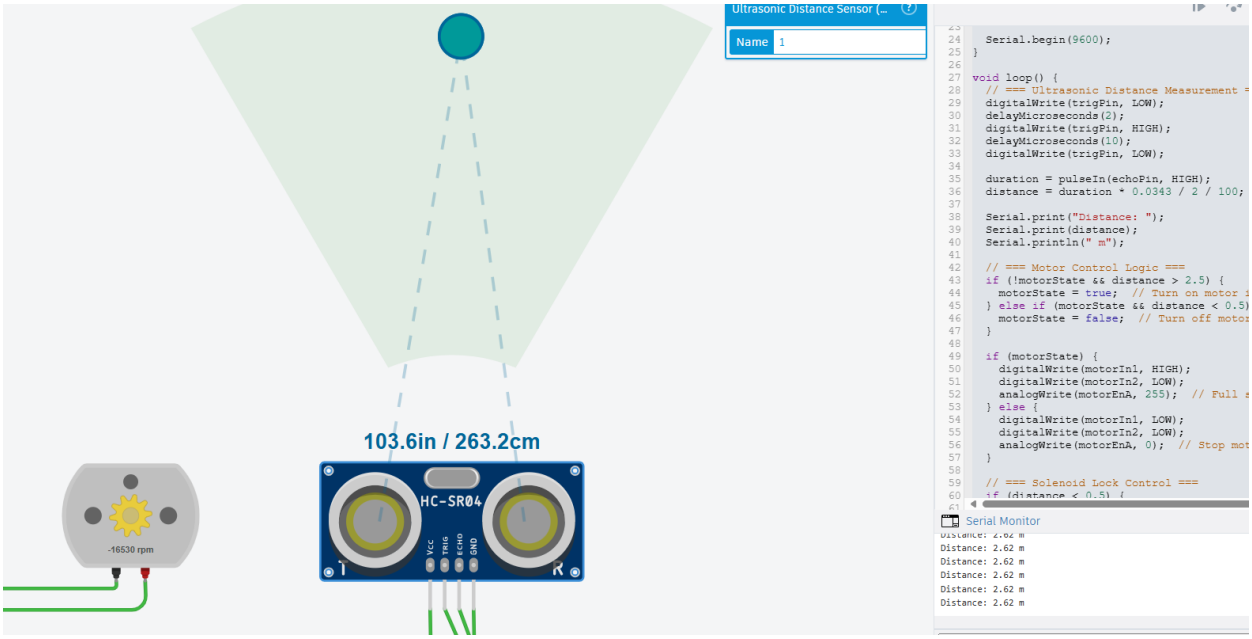


*Figure 20: Moving motor when distance exceeds 2.5 m*

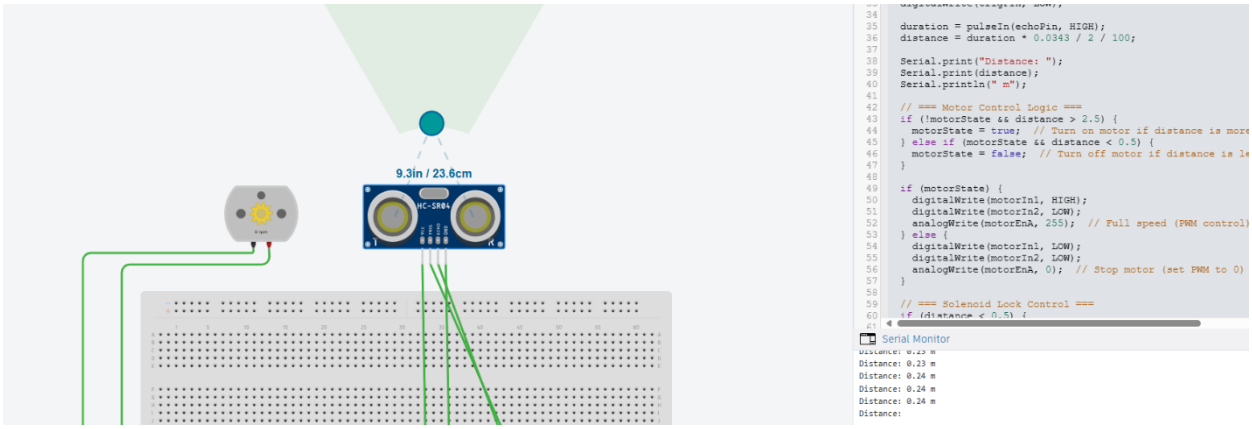


*Figure 21: Motor stopped when distance less than 0.5 m*

### 4.2.3. Test 3

| **Test no** | **3** |
|---|---|
| Objective | To unlock door when RFID tag is scanned |
| Action | A valid RFID tag is scanned in RFID sensor |
| Expected Result | When a valid RFID tag is scanned door should unlock |
| Actual Result | The door was unlocked when tag is scanned |
| Conclusion | The test was successful. |

*Table 3 : Test 3*

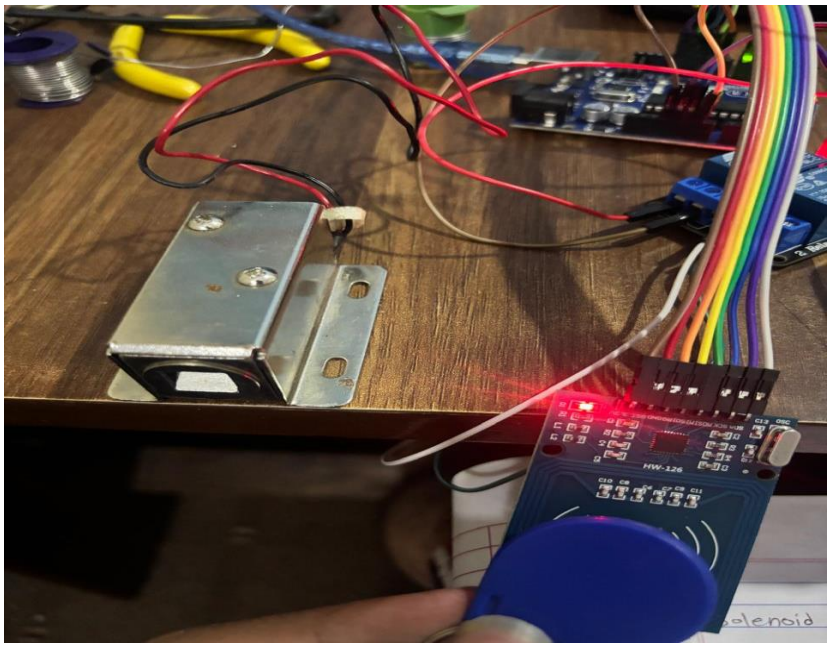

*Figure 22 test 3*

# 5. Future Works

In the future, some improvements can be added to make home automation system better in functioning and in the form of use. If I were trying to add just one thing, I would go for scheduled automation, devices such as lights or fans turn on or off at pre-set times. Motion sensors can be integrated into the system to make it more responsive in the sense that the lights and appliances can be automatically controlled based on human presence. The system would be accessible to the elderly or differently abled individuals using voice assistant integration to Google Assist and Alexa. Equally, putting in temperature and humidity sensors could enable smart regulating fans and exhaust systems on temperature and humidity indoors.

Otherwise, there are also other features like security and sanctity which can be added. Safety is improved by having a notification system that notifies users when the doors are left unlocked and someone enters the house. Door and light unlocking, as well as supporting emergency features like a panic button or disaster alert, can occur automatically during critical events. The system could also have some solar powered components or some energy usage monitoring for ecological friendliness. In addition, including a user-friendly mobile interface and multi user access control will make the system feasible for family usage and give every user different level of control and access.

# 6. Conclusion

In brief, the current project is a perfect illustration of applying Internet of Things (IoT) technologies in the improvement of home automation. Through the integration of RFID based door locking and water pump systems that are controlled by the use of ultrasonic sensors, the project seeks to solve everyday problems in a household, and these are security and water conservation. Arduino as the main controller with modules such as relay modules, motors and different sensors demonstrate how accessible technology can be used to enhance living and this applies mostly to the elderly and differently abled people.

The development included the design, simulation using TinkerCad, assembly, and testing of the circuit and gave some insight on the design, programming, and implementation of the system. The ability of test cases execution ensures the reliability and effectiveness of the adopted solutions. In addition, the project provides a strong background for the further improvement of the project by the implementation of voice assistants, motion sensors, and energy monitoring systems for the creation of a completer and more convenient smart house environment.

In general, this project does not only achieve its major objectives but also exposes the potential of IoT in converting traditional homes into smart living environment which is characterized with convenience, safety and efficiency.

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