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Geo fencing for low flying objects

Mentor:
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GEO FENCING FOR LOW FLYING OBJECTS

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INTRODUCTION:

In this evolving world low flying technology such as drones, UAVs have become a global threat. Initially they are costlier whereas now they are becoming more accessible and affordable for individuals and organizations, and this has led to a surge in their use in various applications. For example, drones are widely used for aerial photography, surveying, and monitoring, while small aircraft are used for recreation, transportation, and research. However, the uncontrolled use of these objects can pose significant risks to public safety and security, such as spying on others and intruding others private space and mostly used by terrorists for supplying the weapons across the border or for bombing purpose and even used by drug dealers

There have been several incidents where drones and small aircraft have caused disruptions in public airspace, such as interfering with commercial flights, invading restricted airspace, and endangering public safety. For example, in 2018, the Gatwick airport in the UKwas shut down for 36 hours due to drone sightings, causing significant delays and disruptions to air travel.
To counteract these threats, we have designed a jamming system that would stop the trespassing and protect the nation & its individuals.

FABRICATION:

To manufacture a drone jamming system, we would target two frequencies : IR frequency & 433 mHz. The actual plan was to create a 2.4 GHz jamming system but, due to financial constraints & delay of parts from the manufacturer, we have decided to switch to the above mentioned frequencies in order to fabricate the jamming system.

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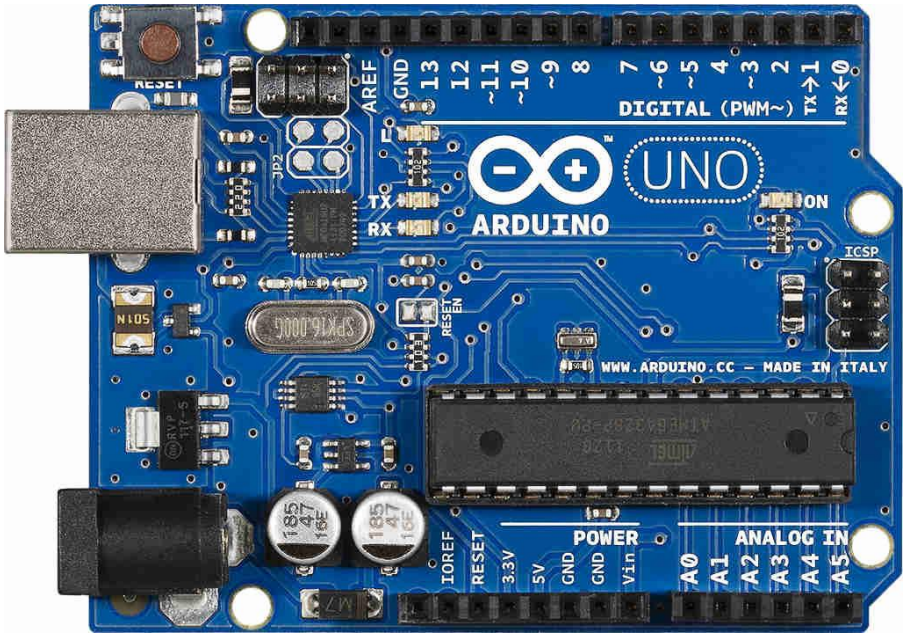
IR Frequency Jammer:

To manufacture the IR frequency jammer we would require the following materials:

Items	Quantity
Arduino Uno	1
Jumper Wire	A6
IR LEDs	2
9v Battery	1
Switch	1

Technical Details:

Arduino UNO



Arduino Uno is an open-source microcontroller board designed for hobbyists and beginners in electronics and programming. It is based on the ATmega328Pmicrocontroller and comes with built-in features such as digital and analog input/output pins, USB connection, and a power jack. Here are some key features of the Arduino Uno board:

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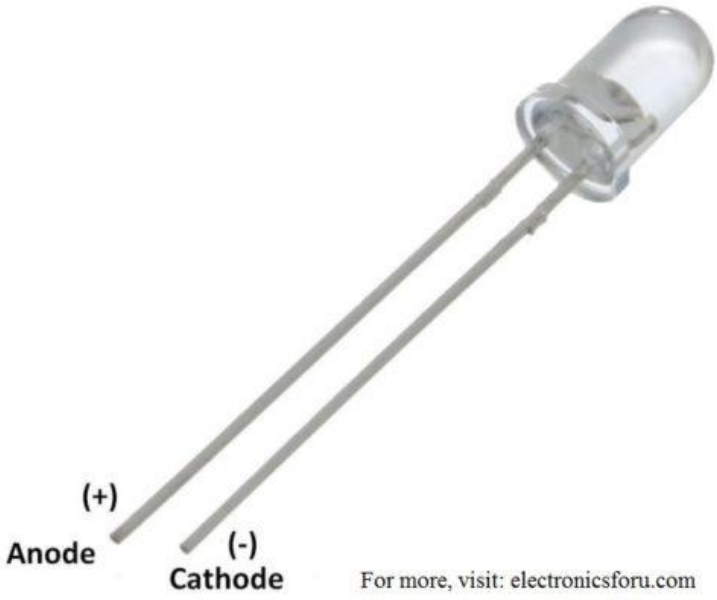
Microcontroller: ATmega328P
Operating Voltage: 5V
Input Voltage: 7-12V (recommended)
Digital I/O Pins: 14 (of which 6 provide PWM output) Analog Input Pins: 6
DC Current per I/O Pin: 20 mA
DC Current for 3.3V Pin: 50 mA
Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader SRAM: 2 KB (ATmega328P)
EEPROM: 1 KB (ATmega328P)

The Arduino Uno board can be programmed using the Arduino Integrated Development Environment (IDE), which provides a user-friendly interface for writing and uploading code to the board. The board can be used for a wide range of projects such as robotics, home automation, and sensor networks.
One of the main advantages of the Arduino Uno board is its ease of use, even for beginners with little or no programming experience. The board is also very versatile and can be expanded with various shields, modules, and sensors to suit different needs. Additionally, there is a large and active community of Arduino enthusiasts who share ideas and resources, making it a great platform for learning and experimentation.

IR LED



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An infrared (IR) LED is a type of light-emitting diode that emits infrared radiation in the range of 700 nanometers (nm) to 1 millimeter (mm), which is invisible to the human eye. IR LEDs are commonly used in electronic devices such as remote controls, security systems, and motion sensors.

Here are some key features of IR LEDs:

Operating Voltage: IR LEDs typically operate at a voltage between 1.2V to 1.6V, and require a current-limiting resistor to protect them from damage.

Wavelength: The wavelength of IR LEDs depends on the material used to make them, and typically ranges from 700 nm to 1 mm.

Forward Current: The forward current of an IR LED determines the brightness of the emitted radiation. Higher forward current values result in brighter radiation, but may also cause theLED to overheat.

Viewing Angle: The viewing angle of an IR LED determines the spread of the emitted radiation. Narrow viewing angles provide focused radiation, while wider viewing angles provide more diffuse radiation.

IR LEDs are commonly used with photodiodes or phototransistors to detect the emitted radiation and convert it into an electrical signal. This makes them useful in applications such as obstacle detection, motion sensing, and proximity sensing. They are also used in communication systems such as IrDA and remote controls.

When using IR LEDs, it is important to handle them with care and to observe safety guidelines, such as using a current-limiting resistor and avoiding direct exposure to the eyes. Additionally, it is important to choose the appropriate wavelength, viewing angle, and forward current for the intended application

We connected the +ve terminal to the Vin pin via a switch. We connected the negative terminal of the battery to the GND pin of the Arduino UNO. Connected the IR LED’s positive terminal to D13 & D12 (digital pin) pins of the Arduino UNO. All the connections were made using jumper wires.

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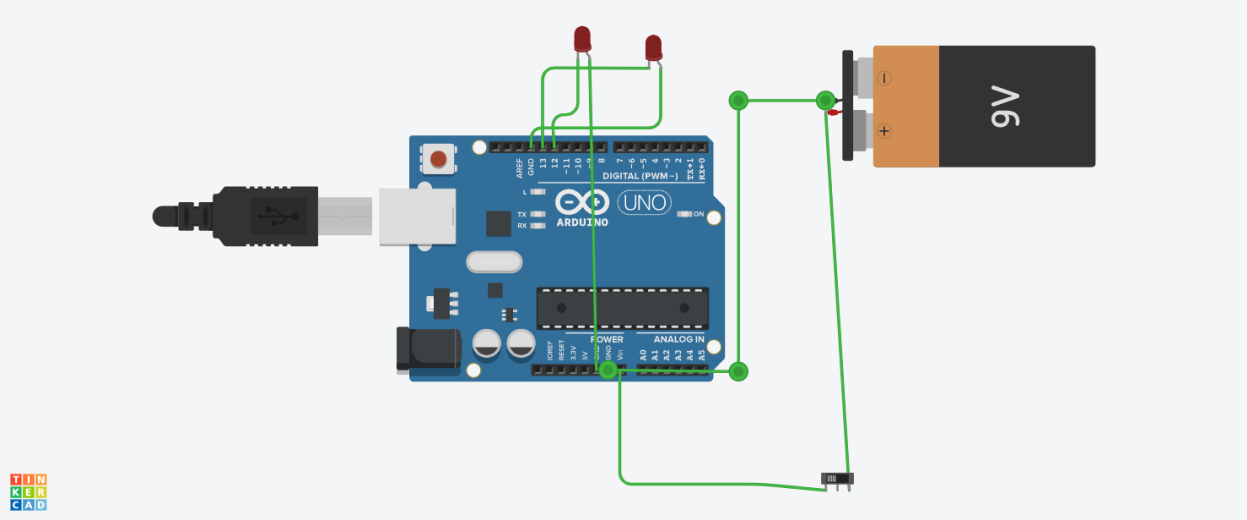

The code below was used to send the IR signal via IR LEDs:

```
int irled1 = 12;
int irled2 = 13;

void setup()
{
  pinMode(irled1, OUTPUT);
  pinMode(irled2, OUTPUT);

}

void loop()
{

digitalWrite(irled1, HIGH);

delayMicroseconds(9);
```

```
digitalWrite(irled1, LOW);

delayMicroseconds(9);

digitalWrite(irled2, HIGH);

delayMicroseconds(9);

digitalWrite(irled2, LOW);

delayMicroseconds(9);

}
```

The code is running successfully and was able to block an IR helicopter that was bought from a commercial shop.

433 MHz Jammer:

To manufacture the 433Mhz frequency jammer we would require the following materials:

Items	Quantity
Arduino Uno	1
Jumper Wire	5
FS1000A Transmitter	1
9v Battery	1
Switch	1

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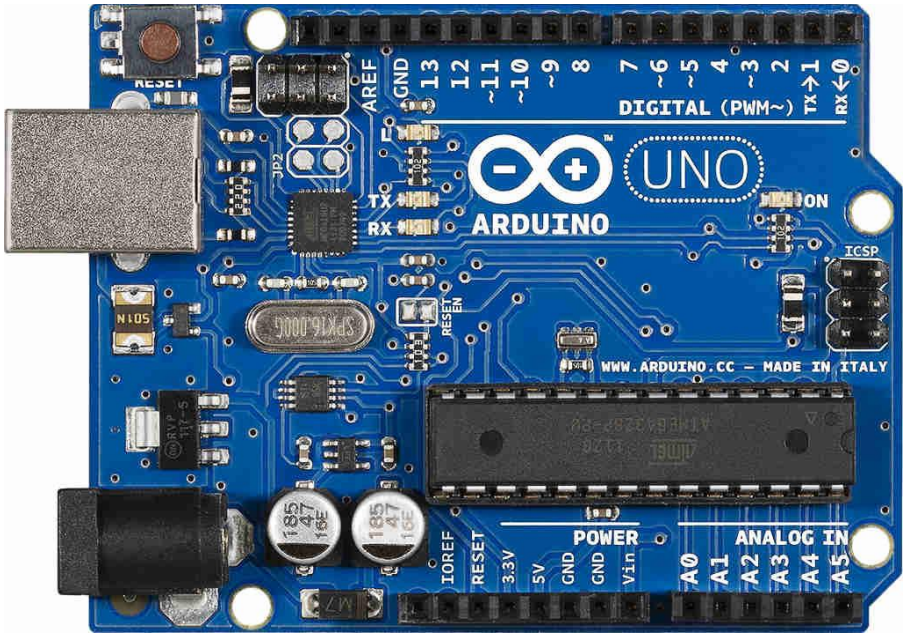
Technical Details:

Arduino UNO



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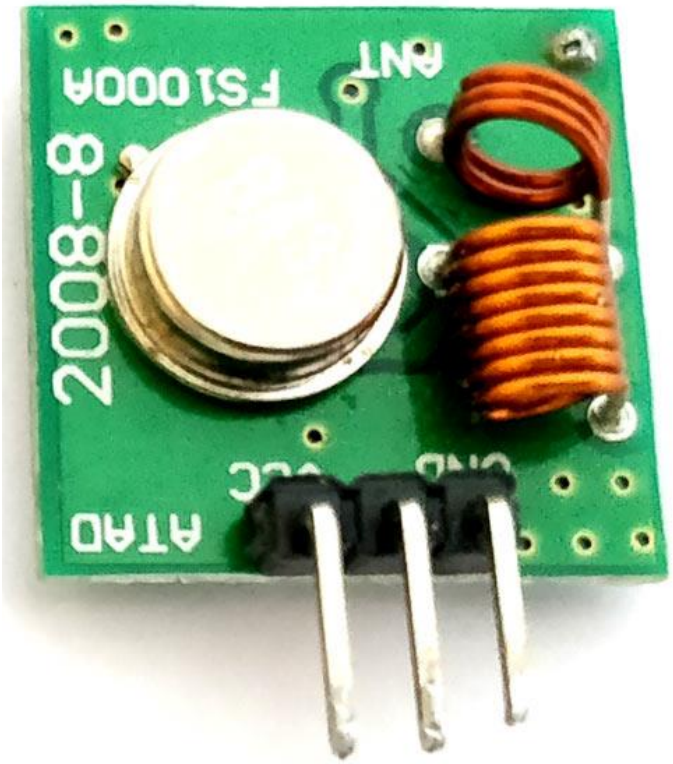
FS1000A



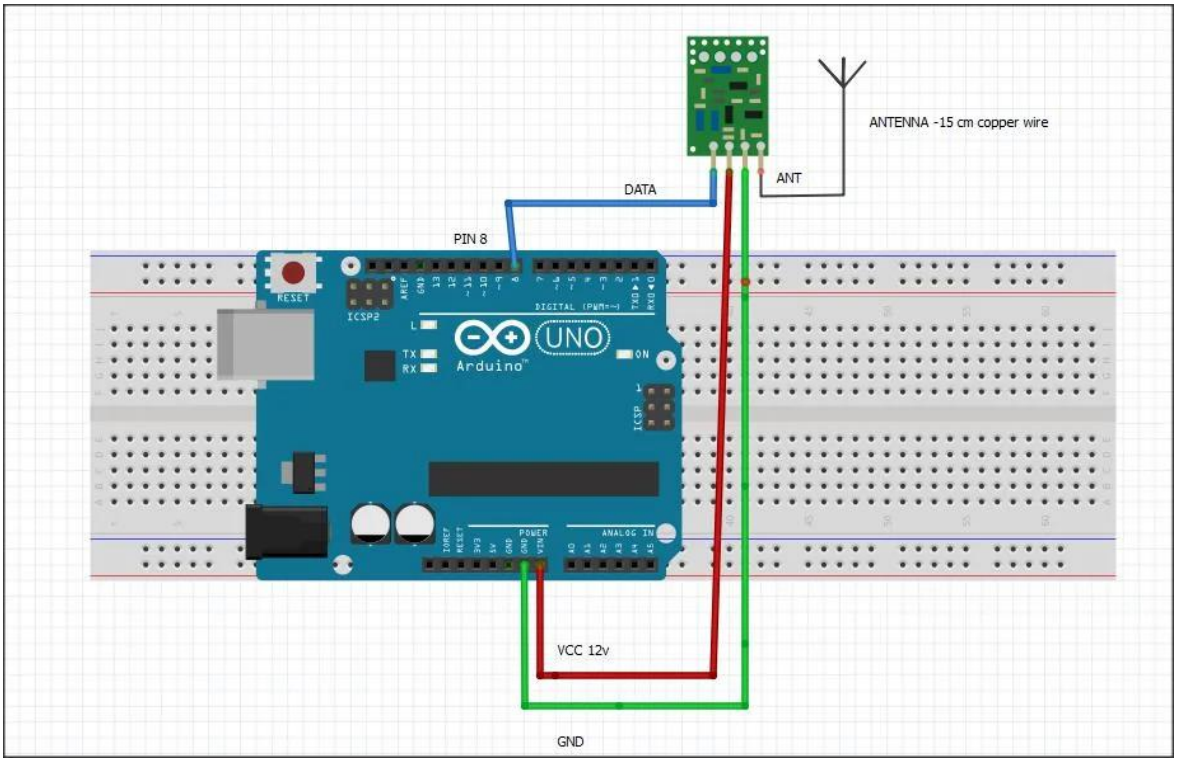
The FS1000A is a low-cost 433MHz radio frequency (RF) transmitter module commonly used in hobbyist projects for wireless communication. It consists of a surface-mounted transmitter chip and a coil antenna that can transmit data up to 300 meters in open air.

The FS1000A transmitter module operates in the 433MHz frequency range, which is a popular frequency band used by many low-power wireless communication devices. It can be used to transmit data wirelessly from one device to another, such as transmitting sensor data from a remote location to a central hub or controlling a remote device like a robot.

The FS1000A transmitter module is relatively easy to use and is often paired with a compatible receiver module for two-way communication. However, it's important to note that it's a low-power device, and the transmission range can be affected by factors such as obstacles, interference, and environmental conditions. Additionally, the FS1000A is not recommended for use in commercial or safety-critical applications due to its limited range and reliability.

Fabrication:

We connected the +ve terminal to the Vin pin via a switch. We connected the negative terminal of the battery to the GND pin of the Arduino UNO. Connected FS1000A's positive terminal to 5V pin , negative terminal to GND pin & data pin to D8 of the Arduino UNO . All the connections were made using jumper wires.



Code:

```
void setup()
{
}
void loop()
{


tone(8, 43000000)


}
```

As there was no availability of a test drone of 433 Mhz, we tested our jammer using another 433Mhz transmitter and receiver pair. It worked fine & was able to jam out the test signal sent.

Results & Conclusion:

- We have successfully completed the fabrication of a multi frequency drone jamming system.
- Due to the lack of funds & shipping time of parts, we were not able to fabricate a 2.4Ghz drone jamming system.
- But with the same theory used in the above fabricated jammer, we can jam 2.4Ghz signal too.
- Jamming signal strength can be increased by using an IR LED array that would induce a more powerful & more coverage signal.
- RF amplifiers can be attached to the output port of the FS1000A transmitter which, when connected to a compatible antenna, would increase the jamming signal significantly.
- Due to the unavailability of a spectrum analyzer, we could not quantify the jamming signal strength at various distances and account for the loss of signal strength vs distance.
- But in our testing through trial & error we could conclude that the IR jammer was most effective when placed over head of the target drone receiver , within 2-3 meters.
- In case of 433Mhz, it was effective until 10 meters, which can be improved using RF amplifier & a better antenna
- With use of multiple jammers, we could design a jamming system with arrays of antennas placed in strategic locations that would create a no-fly zone airspace.

GEO FENCING FOR LOW FLYING OBJECTS

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- We thank our mentors Dr. Manish Kumar Bajpai & Dr. Trivesh Kumar for their constant support, their valuable inputs and their guidance that had helped to design & fabricate this multifrequency drone jamming system.

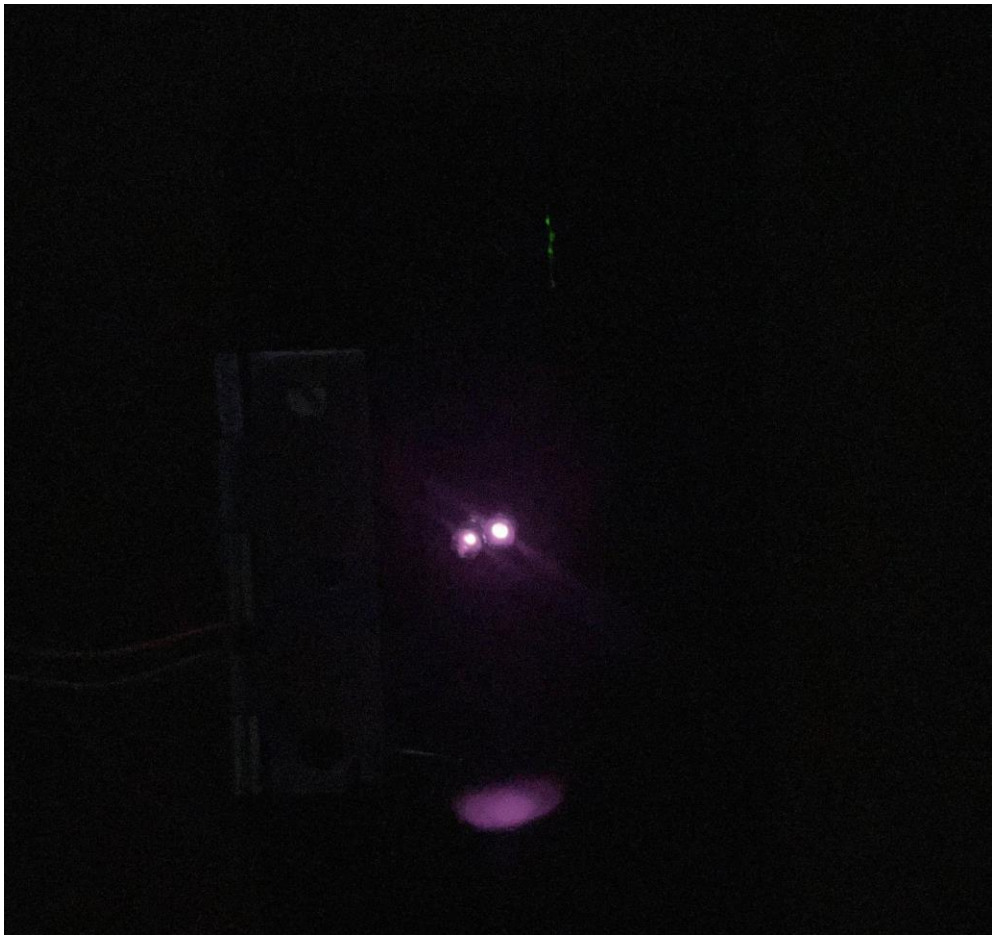

Image (i): IR Jammer in working. Notice the flare of the IR LED captured by the camera.

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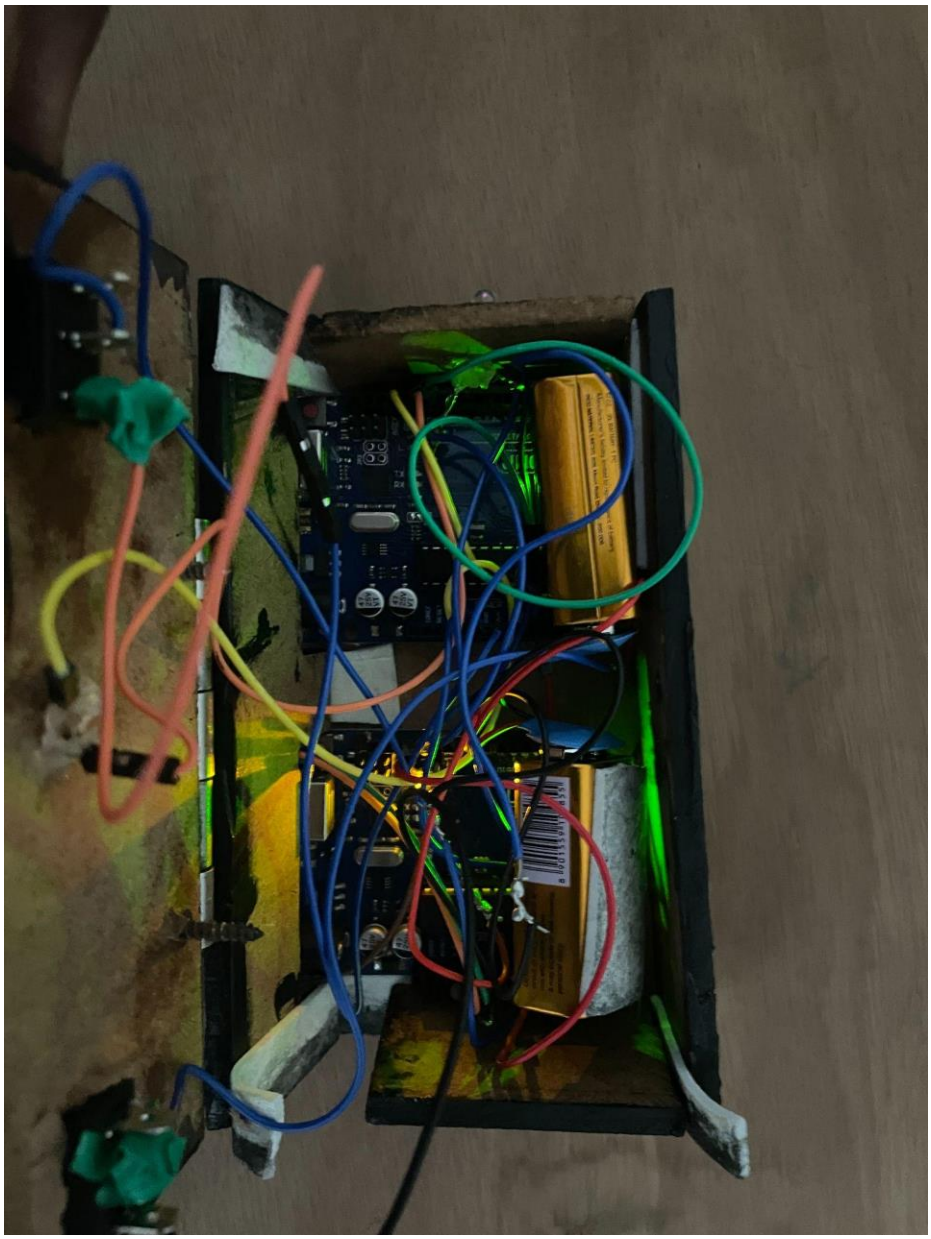

Image (ii): Internal Working of the Jamming system

Dr. Manish Kumar Bajpai

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