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Project Report

Arduino Based RF Controlled Lake/Pool Cleaning Bot With Water Fire Fighting and Disinfectant Sprayer

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Group Profile

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Project Title: Arduino Based RF Controlled Lake/Pool Cleaning Bot With Water Fire Fighting and Disinfectant Sprayer
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Introduction

In response to the rising need for efficient and automated solutions for preserving the cleanliness and hygiene of aquatic settings, we offer our creative creation: an Arduino-based RF-controlled lake/pool cleaning bot outfitted with a water-firefighting and disinfection sprayer. This robotic system combines the power of Arduino technology, radio frequency communication, and a diverse variety of components to provide a comprehensive solution for cleaning and maintaining bodies of water.

At the bot's core is an Arduino Uno, which is controlled by a motor driver shield and directs the movement of two TT gear motors and a submersible pump for water propulsion. The addition of a propeller improves the bot's navigational skills, making it a more agile and effective cleaner. Its capability is further expanded by a servo (SG90), which makes precise control of numerous processes possible.

An Arduino Nano, two joysticks, and a digital input switch on the remote side provide the user with simple, real-time control over the motions and features of the bot. A 433 Hz RF module establishes the connection between the bot and the remote, allowing orders to be transmitted smoothly.

Built with a sturdy foundation made of cork sheets, the bot is both resilient and floatable, making it suitable for a variety of aquatic environments. This proposal incorporates a water fire-fighting mechanism and a disinfectant sprayer to address the aesthetic and health elements of lakes and pools.
The system is intended for prolonged operation and is powered by a 9V battery on the remote and a 3-cell battery configuration on the bot.

To sum up, our RF-Controlled Lake/Pool Cleaning Bot, which is based on Arduino, is a practical and technologically advanced solution that ensures diversity in its applications and provides an automated and effective way to maintain water bodies.

Objective

This project focuses on both surface and groundwater sources in an attempt to provide a thorough assessment of the present state of water pollution in Bangladesh, a country with a dense population. We want to discover and comprehend numerous pollutants, including harmful trace metals and coliforms, that are common in these water bodies through a comprehensive assessment of national and international literature. In order to identify the primary sources of pollution, the inquiry will focus on anthropogenic sources, such as inappropriate waste disposal, untreated industrial effluents, and agricultural runoffs.

Our goal is to assess the related dangers, with a focus on public health. We are particularly concerned about the widespread occurrence of arsenic in groundwater, a serious worry contributing to waterborne illnesses, especially in disadvantaged communities. In addition to offering a thorough picture of Bangladesh's water pollution situation, this research hopes to offer insightful information on risk assessment, environmental health, and the creation of practical mitigation plans. The ultimate objective is to support sustained interventions and well-informed decision-making in tackling the urgent problems caused by waterborne illnesses in this vast country.

Beyond scientific inquiry, this project recognizes the importance of community engagement in addressing water pollution challenges in Bangladesh. We aim to involve local communities in data collection, awareness campaigns, and the implementation of mitigation strategies. By fostering a sense of ownership and collaboration, we seek to create a sustainable impact, empowering communities to safeguard their water resources and improve overall environmental health. Through this inclusive approach, we envision a resilient and informed community actively contributing to the long-term success of water quality initiatives.

Literature Review

Water pollution, particularly from plastic waste, has emerged as a significant global environmental threat. Rivers and lakes are particularly vulnerable to this pollution, serving as conduits for plastic waste from land-based sources. This plastic waste poses a severe hazard to aquatic ecosystems, human health, and the overall sustainability of water resources.

In response to this growing challenge, researchers and innovators have developed various strategies to address plastic pollution in waterways. One promising approach involves the use of Arduino-based remote-controlled robots for collecting plastic and other trash from rivers and lakes. These robots offer several advantages over traditional methods of manual collection, including

Increased Efficiency:

Arduino-based robots can operate continuously and tirelessly, covering larger areas and collecting more waste compared to manual labor.

Reduced Human Labor:

These robots eliminate the need for human workers to engage in hazardous tasks, minimizing the risk of exposure to harmful substances or hazardous environments.

Adaptability to Hazardous Environments:

Arduino-based robots can navigate challenging environments, such as polluted waters or difficult-to-access areas, where manual collection is impractical or dangerous.

Data on Plastic Waste in Rivers and Lakes:

The Buriganga River in Dhaka, Bangladesh, carries an estimated **192,000 tonnes** of plastic waste annually.

The Karnaphuli River in Chittagong, Bangladesh, has a concentration of microplastics 10 times higher than the global average.

A study by the World Wildlife Fund (WWF) found that **80%** of the plastic waste found in the Buriganga River in Dhaka is from land-based sources.

A study by the Bangladesh Center for Advanced Studies (BCAS) found that the concentration of microplastics in the Karnaphuli River in Chittagong is **1,000 microplastics per liter** of water.

A study by the University of Dhaka found that the consumption of fish contaminated with microplastics by children in Bangladesh is causing a number of health problems, including cancer, respiratory problems, and developmental delays.

Potential for Wider Adoption:

Arduino-based remote-controlled robots offer a cost-effective alternative to commercially available solutions like Clearbot and WasteShark, which are often prohibitively expensive. These robots can be constructed using readily available components and open-source software, making them more accessible to individuals, organizations, and communities with limited budgets.

Further Research and Development:

Further research and development are crucial to optimize the design, performance, and autonomy of these robots, ensuring their widespread adoption and effectiveness in cleaning up our waterways. Potential areas for improvement include:

Enhancing navigation capabilities to enable robots to operate autonomously in complex environments.

Improving waste detection and collection efficiency with more sophisticated sensors and gripper mechanisms.

Developing sustainable power sources, such as solar or water power, to reduce reliance on grid electricity and minimize the environmental impact of robot operation.

Exploring the potential for artificial intelligence (AI) to enhance the robots' decision-making and adaptation capabilities.

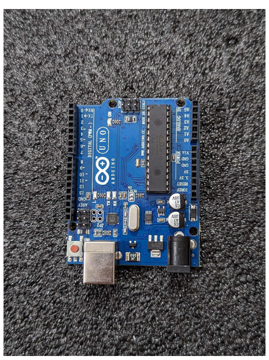
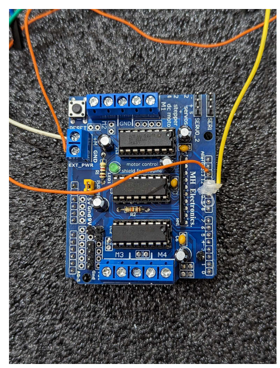
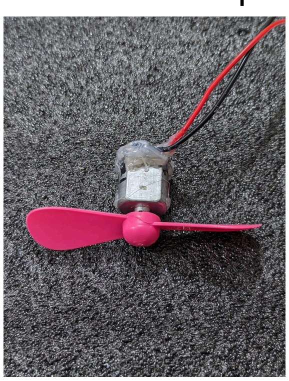
Investigating the use of biodegradable materials in the construction of robots to reduce their environmental impact.

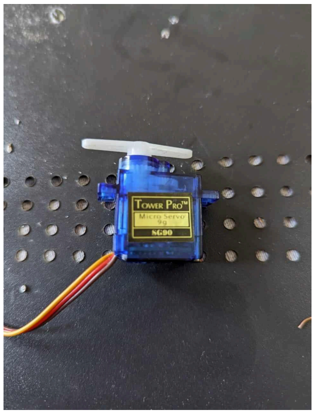
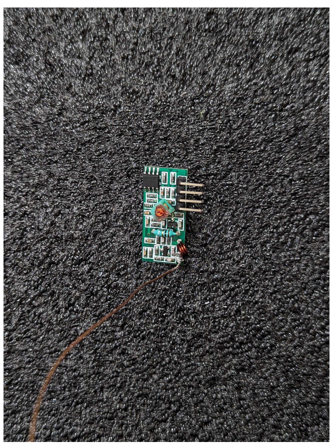
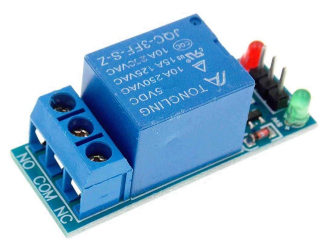
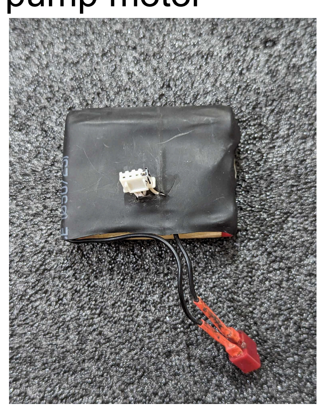
By addressing these areas, we can harness the power of Arduino-based remote-controlled robots to effectively combat plastic pollution and restore the health of our waterways.

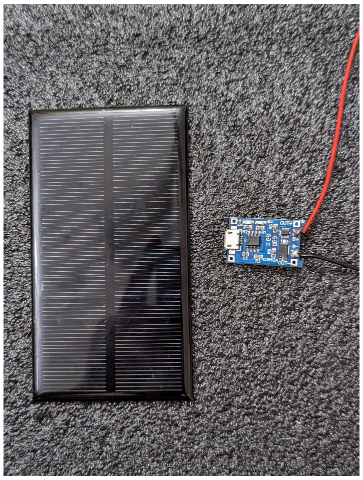
Materials & Methods

In this section, we provide a concise overview of the materials and methods employed in the development of the Arduino-based RF Controlled Lake/Pool Cleaning Bot. The materials encompass a carefully selected array of electronic and structural components, each serving a specific purpose in the bot's design. The methods employed for assembly, programming, testing, and safety considerations are outlined, offering a glimpse into the systematic approach adopted to bring the project to fruition. This section serves as a guide to the practical aspects of the project's implementation, offering transparency and clarity regarding the tools and techniques employed in its realization.

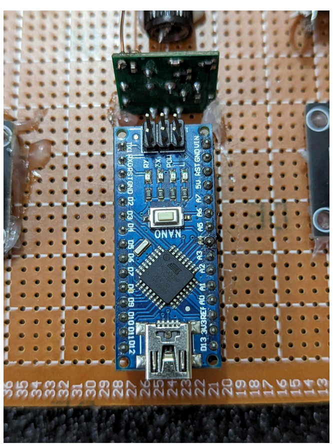
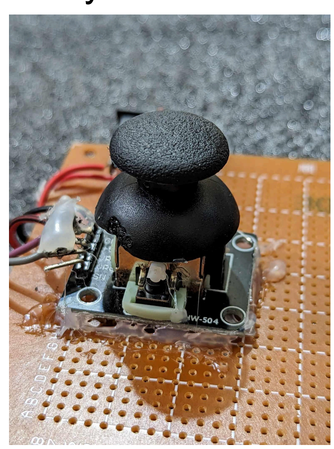
On Bot Side:

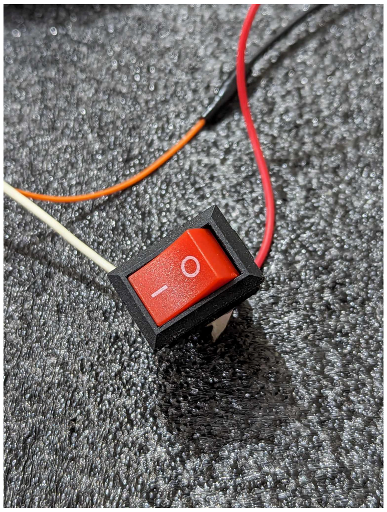
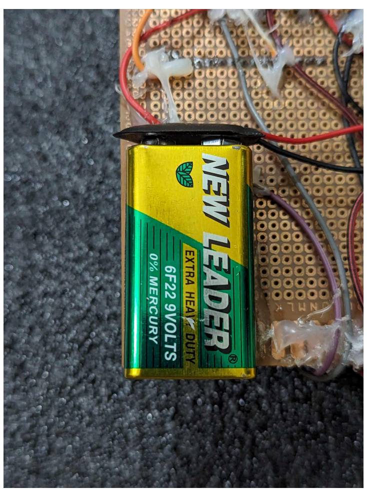
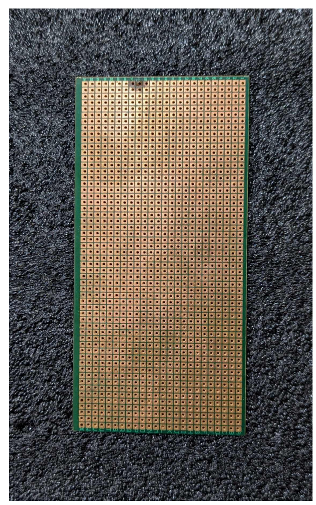
1. Arduino Uno 	2. Motor Driver Shield 
3. 2xMotor & Propeller 	4. 1xSubmersible Pump(12v, 8watt) & Nozzle and tube for spraying water 

5. 1xSG90 Servo  	6. 3-Cell Lithium Battery (3.7V each) and Case 
7. 433Hz RF Module(Receiver) 	8. 1x1 Channel 5V Relay Board Module 
9. Cork Sheet & PBC Board (structural components) 	10. Another Battery For the pump motor 

11. Solar plate and charging module to charge one battery 

On Remote Side:

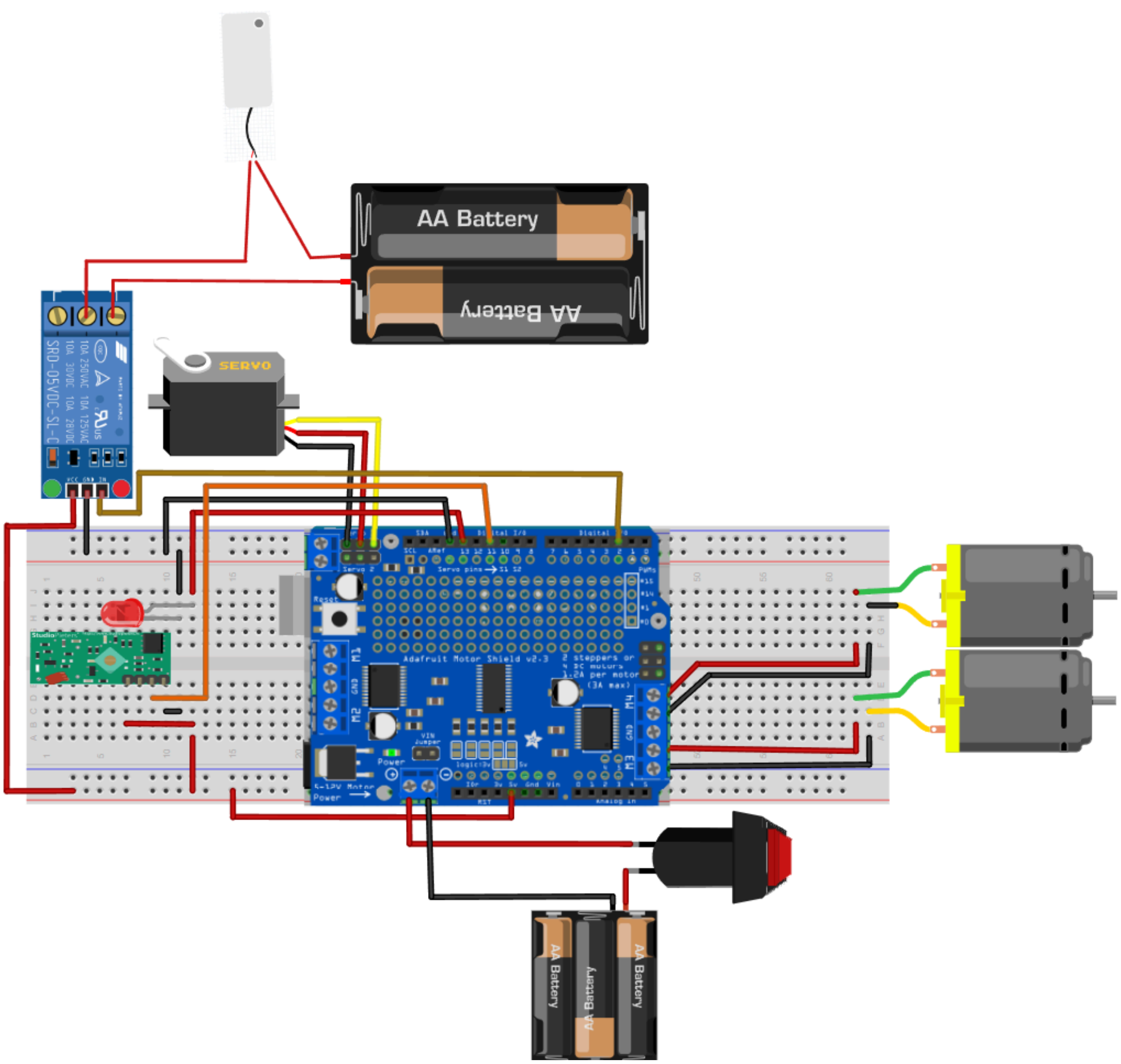
1. Arduino Nano 	2. 2xJoysticks 

3. 2xSwitch (Digital Input & Power on/off) 	4. 433Hz RF Module (Transmitter) 
5. 9V Battery  	6. PCB Board 

Implementation

Assembly Of The Bot:

To begin, we must place the Adafruit Motor Driver Shield on top of our Arduino Uno. The components must then be connected according to the diagram below. The pump motor runs on a 12-volt direct current and requires a 1.2A current. Motor Driver Shield can provide 0.62A. So we attached an external battery to the pump motor and used a relay module to control it.



Note: If we want to power the Arduino separately we need to disconnect the yellow jumper cable situated just beside the shield power input terminal.

Bot Side Code:

To use the 433mhz module we need to install the Radio Head library. To use the motor driver shield we need to install the Adafruit Motor driver shield V1 library. The Radio Head library conflicts with the normal servo library. So we need to install the ServoTimer2 library. We don't need to install the SPI library. It's pre-installed in the Arduino IDE.

```
#include <RH_ASK.h>
#include <SPI.h>
#include "ServoTimer2.h"
#include <AFMotor.h>

#define MAX_SPEED 250
#define MAX_SPEED_OFFSET 20

ServoTimer2 spray_Angle;

AF_DCMotor motorLeft(3);
AF_DCMotor motorRight(4);
RH_ASK rf_driver;

int boat_Joystick_x;
int boat_Joystick_y;
int spray_Joystick_x;
int sprayPosition;
int sprayState;

void setup() {
  Serial.begin(9600);
  setDefult();
  spray_Angle.attach(10);
  spray_Angle.write(sprayPosition);
  if (!rf_driver.init()) {
    Serial.println("RF driver initialization failed");
  }
}

void loop() {
  uint8_t buf[4];
```

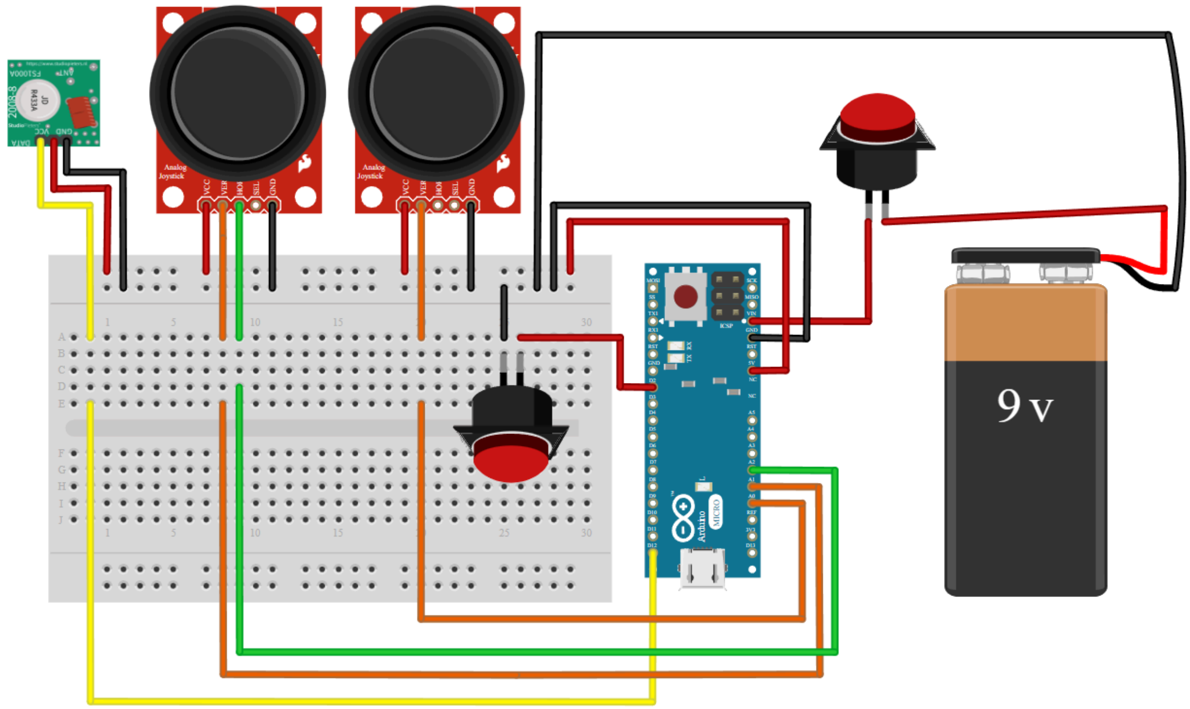
```
  uint8_t buflen = sizeof(buf);
  if (rf_driver.recv(buf, &buflen)) {
    digitalWrite(13, HIGH);

    sprayPosition = buf[0];
    sprayState = buf[1];
    boat_Joystick_x = buf[2];
    boat_Joystick_y = buf[3];

    controlMotors();
    spray_Angle.write(map(sprayPosition, 0, 180, 750, 2250));

    if (sprayState == 0) {
      digitalWrite(2, HIGH);
    } else {
      digitalWrite(2, LOW);
    }
    digitalWrite(13, LOW);
  } else {
    setDefult();
    stopMotors();
  }
}

void setDefult() {
  boat_Joystick_x = 511;
  boat_Joystick_y = 511;
  sprayPosition = 1550;
  sprayState = 1;
  pinMode(13, OUTPUT);
  pinMode(2, OUTPUT);
  digitalWrite(2, LOW);
}

void controlMotors() {
  if (boat_Joystick_x * 4 >= 800) {
    moveForward();
  } else if (boat_Joystick_x * 4 <= 250) {
    moveBackward();
  } else if (boat_Joystick_y * 4 >= 800) {
    turnRight();
```

```
  } else if (boat_Joystick_y * 4 <= 250) {
    turnLeft();
  } else {
    stopMotors();
  }
}

void moveForward() {
  motorLeft.run(FORWARD);
  motorRight.run(FORWARD);
  accelerateMotors();
}

void moveBackward() {
  motorLeft.run(BACKWARD);
  motorRight.run(BACKWARD);
  accelerateMotors();
}

void turnRight() {
  motorLeft.run(FORWARD);
  motorRight.run(BACKWARD);
  accelerateMotors();
}

void turnLeft() {
  motorLeft.run(BACKWARD);
  motorRight.run(FORWARD);
  accelerateMotors();
}

void accelerateMotors() {
  for (int speedSet = 0; speedSet < MAX_SPEED; speedSet += 2) {
    motorLeft.setSpeed(speedSet);
    motorRight.setSpeed(speedSet);
    delay(5);
  }
}

void stopMotors() {
  motorLeft.run(RELEASE);
```

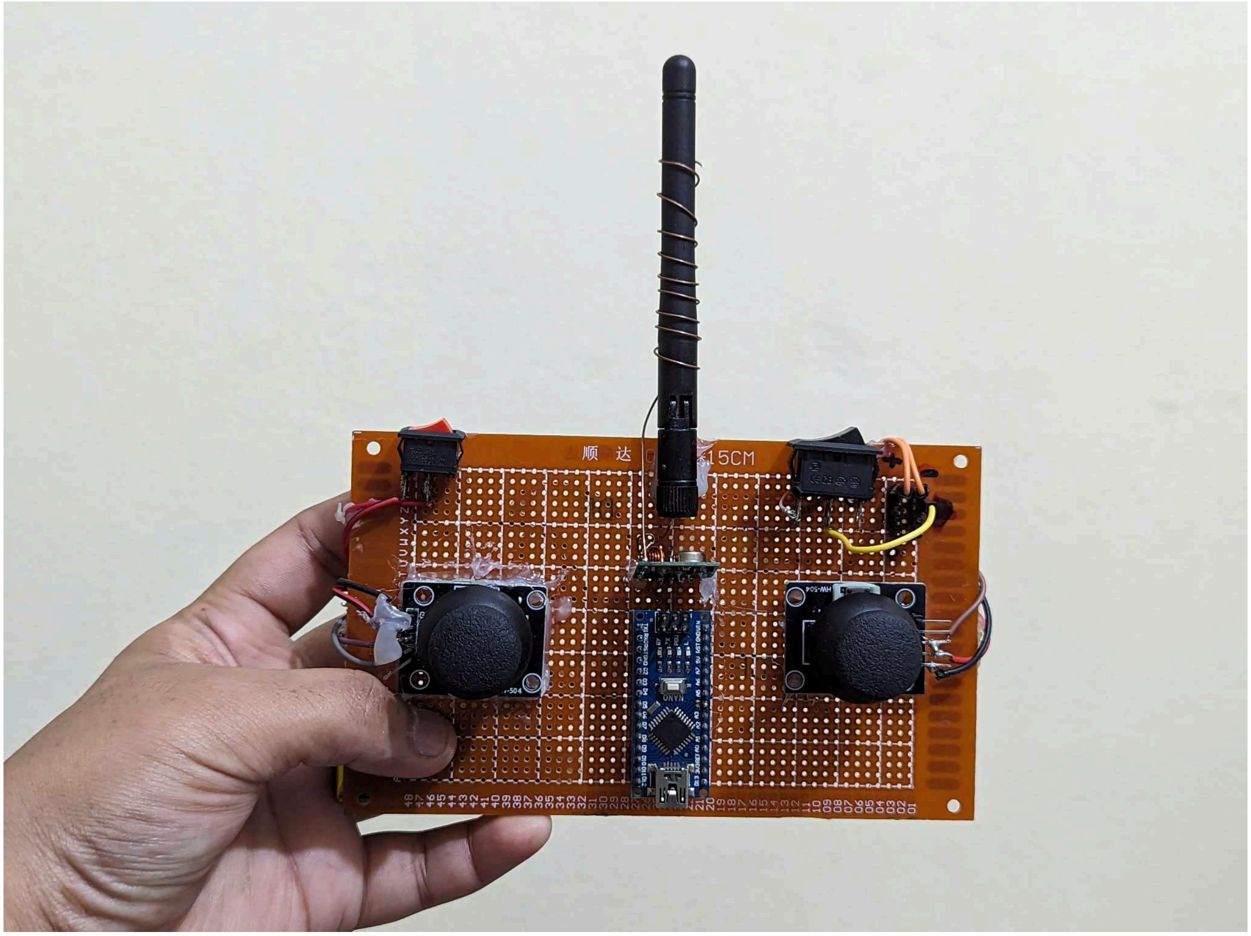
```
  motorRight.run(RELEASE);
}
```

Assembly Of The Remote:

We need to connect the components following the diagram below.



We are using 2 joysticks to move our boat left, right forward, and backward. Using a switch as a digital input to control our spray state. The final look looks like this:



Remote Code:

```
#include <RH_ASK.h>
#include <SPI.h>

#define S_VRX_PIN A0
#define B_VRX_PIN A1
#define B_VRY_PIN A2
#define SPRAY_SWITCH_PIN 2

RH_ASK rf_driver;


int boat_Joystick_x = 511;
int boat_Joystick_y = 511;
int spray_Joystick_x = 511;
int sprayPosition = 89;
```

```
int sprayState = 1;

void setup() {
  rf_driver.init();
  pinMode(SPRAY_SWITCH_PIN, INPUT_PULLUP);
}

void loop() {
  sprayState = digitalRead(SPRAY_SWITCH_PIN);

  boat_Joystick_x = analogRead(B_VRX_PIN);
  boat_Joystick_y = analogRead(B_VRY_PIN);
  spray_Joystick_x = analogRead(S_VRX_PIN);

  sprayPosition = map(spray_Joystick_x, 0, 1023, 0, 180);

  uint8_t buf[4];

  buf[0] = sprayPosition;
  buf[1] = sprayState;
  buf[2] = boat_Joystick_x / 4;
  buf[3] = boat_Joystick_y / 4;


  rf_driver.send(buf, sizeof(buf));
  rf_driver.waitPacketSent();
}
```

Conclusions and Future Plans

In conclusion, the development of the Arduino-based RF Controlled Lake/Pool Cleaning Bot marks a promising step in addressing aquatic pollution. The successful implementation of remote control functionality lays the groundwork for future endeavors toward autonomy. The current system showcases the potential of technology in enhancing aquatic debris collection.

Future Plans:

The next phase of this project will focus on transitioning the bot into a fully autonomous system. This evolution involves refining autonomous navigation, incorporating advanced sensors, and optimizing trash collection algorithms. The goal is to create a seamlessly integrated, efficient, and community-friendly autonomous solution.

By embracing autonomy, we aim to enhance the bot's capabilities for widespread and sustained impact. Continued community engagement will remain a key aspect, ensuring that technological advancements align with the needs and expectations of local communities. The future of this project envisions an autonomous bot actively contributing to cleaner and healthier aquatic environments, guided by principles of sustainability and innovation.