SECRET BOT

A BLUETOOTH CONTROLLED SPY ROBOT

Rabbani Rasha   1310972642

Alin Mostafa   1510262042

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ABSTRACT

Secret Bot: A Bluetooth Controlled Spy Robot is an Arduino
Uno based robot that can be monitored and controlled by an
Android device using an Android application. The Wireless
Network Camera mounted on the robot can also be displayed
on any other Android/iOS device for monitoring. In this project
simple materials are used like plastic wood for the chassis,
cycle spokes for the wheel axle, L293D motor driver and two
600 rpm DC motors for propulsion in four directions namely
front, reverse, left and right. Bluetooth module HC-05 is used
to receive commands in the form of strings from the Android
application. The robot is covered with camouflage texture so
that it does not alert surroundings. It is made up of simple
materials rather than preassembled kits because the
materials are readily and cheaply available, the robot becomes
very lightweight and it can be formed into any desired size.

Contents

1. Introduction

Secret Bot is based on Arduino Uno R3, a microcontroller board (AVR development board) based on the ATmega328P AVR microcontroller unit, which is connected with the two motors through the L293D motor driver. It is also powered by a 7.4 Volts Rechargeable Lithium-Polymer battery. The Wireless Network Camera uses Wi-Fi network and is also powered by the battery.

1.1 Problem Statement

Every day in the world, incidents are taking place that pose life threatening consequences of human intervention. In these cases, involvement of human is very risky. For example, investigating potential crime scenes like bomb sites and dealing with hostage situations can be hazardous for forces like police and army and also for hostages themselves. If terrorists sense that law enforcement is coming to them, they would wreak havoc. Something can go wrong that the enforcement is not aware of, like bomb explosion or human casualties. The July 2016 Dhaka attack at the Holy Artisan restaurant claimed many innocent lives of both hostages and police members, which happened due to lack of proper strategic plan as police could not know what was happening inside the restaurant [1]. This would not happen if enforcers carried out their operations without letting the terrorists know. The Secret Bot should be capable to handle these type of situations, by carrying out stealth operations independently like locating vantage points and the position of threats and hostages, that require no human intervention except controlling it remotely. By using the Secret Bot, enforcers and other agencies could pinpoint strategic problems from distance and then lay out an effective plan accordingly. The robot should not disturb the crime spot in anyway, as it would be small in size and silent having no alarms and lights and have camouflage texture.

1.2 Technical Specifications:

Operating Environment: Arduino IDE

Form Factor: Vehicular

IP Camera app: Keyes

Bluetooth Controller app: Arduino Bluetooth Controller.

2. Existing Systems

During the course of this project, we came across various efforts and strategies done in similar directions. Similar efforts and their strategies are illustrated below.

- Spy robots already do exist commercially that are used extensively in military operations, which are very expensive. Examples include Military Spy Robot by Recon Robotics and Gladiator Tactical Unmanned Ground Vehicle by US Marine Corps.
- Spy Night Vision Robot is a computer controlled spy robot that can act as a live telecast of audio and video information (including night vision) from the surroundings and can be sent to a remote station through RF signals to maximum range of 200 meters. It can measure the distance of object at front of robot and also automatically stop robot if a distance of object inside 10 cm is detected [4].
- Smart Spy Robot is a robotic spy vehicle using RF technology for remote operation that can be monitored using webcam attached to it by wirelessly transmitting real-time video and will give confidential information regarding opposite parties [5].

3. Architecture Overview

The following are the components present in Secret Bot system:

- iOS/Android Application (app): This is the client side of the system. The network camera relays data to the Keyes app for viewing footage and the Bot's Bluetooth module relays data to the Arduino Bluetooth Controller app for remote controlling the Bot.
- Camera: Wi-Fi Network IP Camera with night vision.
- Arduino Uno: For processing signal data to control the Bot's DC motors according to the code programmed to it.
- HC-05 Bluetooth Module: For receiving Bluetooth signals in the form of strings that are given by the user through the controller app
- L293D Motor Driver: This is a dual H-bridge motor driver that controls the DC motors according to the pin mode stated by Arduino.
- Left and Right Motors: They are fitted to each of the rear wheels to rotate the wheels so that the Bot can move.

3.1 Architecture of the System

The architecture of Secret Bot is shown below. It is represented as functional block diagram and wiring connections, included with a summary of instructions that are coded into the Arduino using Arduino IDE in C/C++ language. The Arduino decides which string received corresponds to which rotation state of the motors according to these instructions.
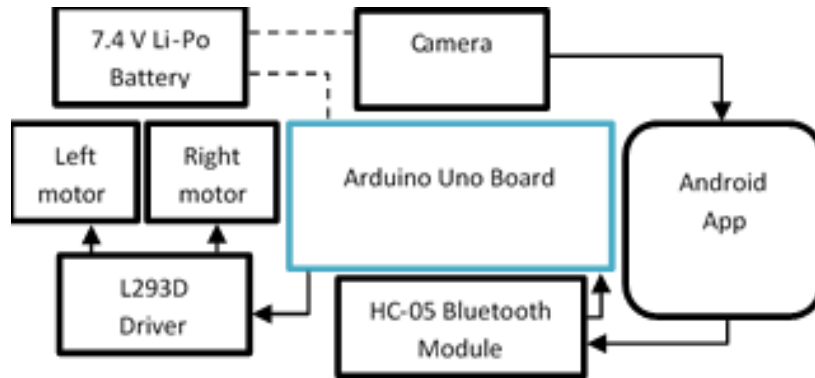
Figure: Functional Block Diagram

Button	String	Result
Left	L	Left motor backward, Right motor forward
Right	R	Left motor forward, Right motor backward
Up	F	Left motor forward, Right motor forward
Down	B	Left motor backward, Right motor backward
Stop	S	Left motor off, Right motor off

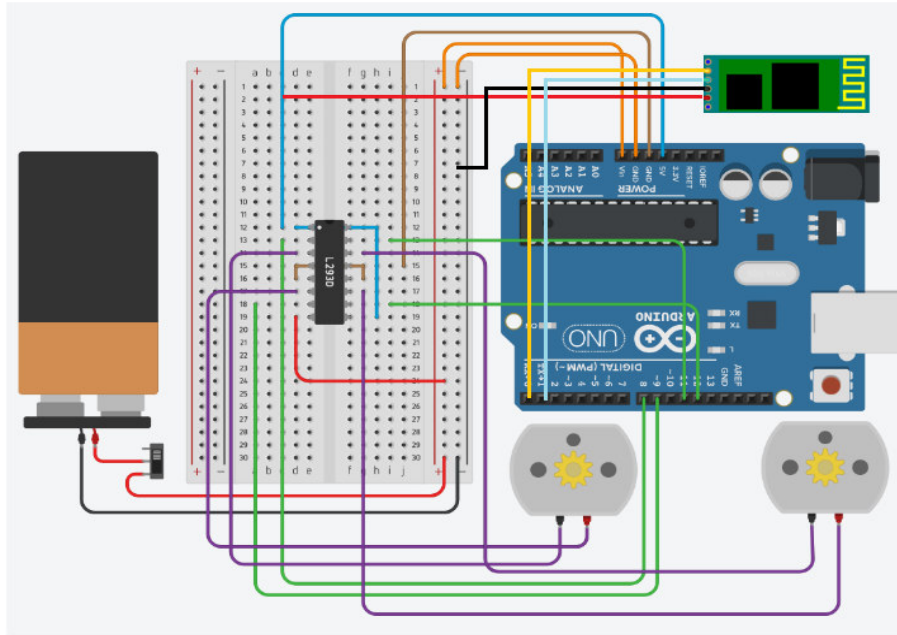Table: Instructions programmed to the Arduino

Figure: Wiring Diagram

3.2 User Perspective of the System

The user simply turns on the slide switch of the robot to power it on, runs the apps on the mobile devices, and after pairing the robot with the device by entering security key and connecting the camera with the app through Wi-Fi network, the robot can be controlled by pressing the buttons while watching the footage sent by the camera. User can capture the footage as images or videos and save them or share across devices.

3.3 Challenges for Secret Bot

- The robot can go as far as 100 meters maximum from the controlling device (Bluetooth range) depending on the Wi-Fi network.
- Mobile Wi-Fi hotspot of the controlling is preferred as ambient Wi-Fi networks can be poor in performance, hindering view of footage.
- Propulsion speed of the Bot is not that much due to motor limitation but torque is high due to low gear ratio of the motors.

- The robot is lightweight and not armored so it cannot avoid damages. However, it is durable as long as it is handled with care and it can be used for many days with a single recharge.
- Although it has camouflage body for its purpose, it cannot be ensured that it will be fully hidden during operation.

3.4 Approach

Unlike most related systems which use remote controllers that communicate with robot through Radio Frequency (RF) signals, the proposed system uses an Android device that communicates with robot through Bluetooth signal. This approach is better because Android devices in the form of smartphones and tablets are very portable and widely used [6]. The robot can be controlled from any Android device if the passkey for pairing is known, so it will not be a problem even if the Android device is not working.

4. Product Overview

4.1 Hardware Description

Hardware devices used in this system are given below:

4.1.1 Arduino Uno R3

Arduino Uno R3 is a microcontroller board based on the ATmega328P that can be programmed by any Personal Computer through USB interface [7]. Instructions are programmed into Arduino using C/C++ language and Arduino IDE [8].

4.1.2 L293D Motor Driver

The L293D is a typical Motor driver IC which allows the DC motor to be driven in either direction according to the way it is coded. It is a 16 pin IC which can control two DC motors simultaneously in any directions with the help of the code. The IC uses an input of 5 volt at pin 8 and 16 as well as pin 1 and 9 which is enable, the other pins 4, 5, 12 and 13 are grounded. The inputs to the IC's pin no 2 and 7 are for the first motor connected at pin 3

and 6. The inputs to pin 10 and 15 are for the second motor which is connected at pin no 11 and 14. The inputs are logic 0 or logic 1 given from digital pins 8, 9, 11 and 12 of the Arduino Uno [9].

4.1.3 HC-05 Bluetooth Module and Arduino Uno R3

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The Vcc, GND, RX and TX pin of the module is connected to 5V, GND, TX and RX pin of the Arduino respectively. The module used in the project communicates at a baud rate of 38400 bits per second [10].

4.1.4 Wireless Network Camera

The Wireless Network Camera, also known as Wi-Fi IP Camera, is used in this system to stream videos live to any mobile device, including Android and iOS devices, using Wi-Fi network. It can also capture photos and videos which can then be shared across other devices and cloud services. It also has infrared supported night vision and an integrated microphone and speaker for audio transmission between itself and the mobile device. Furthermore, it can also rotate approximately 360 degrees both horizontally and vertically [11].

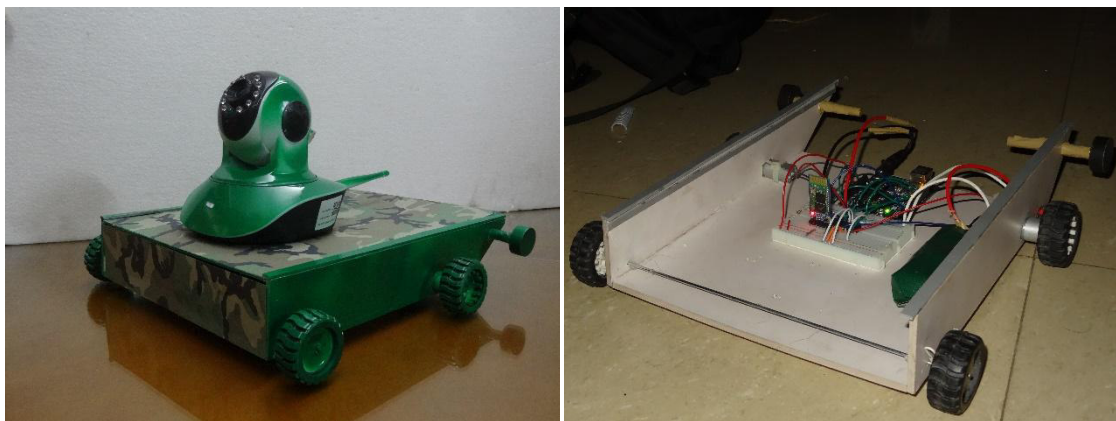## 4.2 Product Description

4.2.1 The Secret Bot

Figure: (a) The Secret Bot, (b) Early development stage of the Bot

The Secret Bot has two 600 rpm DC motors attached to the rear wheels. All the hardware is connected on a breadboard according to the circuit shown in Architecture of the System.

4.2.2 The camera Interface

Figure: The interface showing footage in dark

The camera interface of the Android/iOS application displays live footage of the Network Camera, including night vision (aided by infrared sensors), which is ideal for spying. The camera can be rotated by swiping on the footage screen in desired direction. The footage can be captured as image or video, which can then be shared across devices including other mobile devices, computer through Wi-Fi network, Bluetooth, or cloud services like Google Drive and OneDrive.
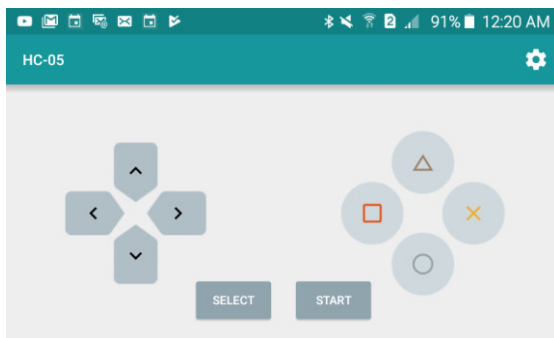
4.2.3 The Controller Interface

Figure: The Controller Interface

The controller interface of the android application consists of custom buttons that can be assigned strings to be transmitted to the HC-05 module through Bluetooth signal. Using these strings, the Secret Bot will decide whether to move forward, backward, left or right, or stop. For a new device, the pairing key should be entered to access this interface.

5. Testing

Figure: Final System Testing

All the components have been tested and it is seen to be working properly. As shown in Figure 8(b), the robot is active by looking at the red light of the Bluetooth module and green light of the Arduino. During the final testing shown in Figure 11, everything worked as expected. After testing, the wires are soldered to the breadboard for reliability.

5.1 System Functionalities

- Blends in with its surroundings by having a camouflage body
- Small and lightweight in size
- Locates vantage points, objects and beings through the IP camera.
- Goes as far as 100 m from the controller device [12]
- Relays visual information from night vision IP camera back to person
- Its control can be taken by any person through security (pairing) key when necessary
- Require no human intervention while in operation

5.2   Implementation

```
int leftMotorF=8;
int leftMotorB=9;
int rightMotorF=12;
int rightMotorB=11;
String readString;
void setup()
{
  Serial.begin(38400);
  pinMode(leftMotorF, OUTPUT); // initialize the pin as
an output.
  pinMode(rightMotorF, OUTPUT); // initialize the pin as
an output.
  pinMode(leftMotorB, OUTPUT); // initialize the pin as
an output.
  pinMode(rightMotorB, OUTPUT); // initialize the pin as
an output.
}
void loop()
{
  while(Serial.available())
  {
    delay(50);
    char c=Serial.read();
    readString+=c;
  }
  if(readString.length()>0)
  {
    Serial.println(readString);
    if(readString =="F") //Front
    {
      digitalWrite(rightMotorF, HIGH);
      digitalWrite(rightMotorB, LOW);
      digitalWrite(leftMotorF, HIGH);
      digitalWrite(leftMotorB, LOW);
    }

    if(readString =="B") //Back
    {
      digitalWrite(rightMotorF, LOW);
      digitalWrite(rightMotorB, HIGH);
      digitalWrite(leftMotorF, LOW);
      digitalWrite(leftMotorB, HIGH);
    }

    if(readString =="L") //Left
```

```
    {
        digitalWrite(rightMotorF, HIGH);
        digitalWrite(rightMotorB, LOW);
        digitalWrite(leftMotorF, LOW);
        digitalWrite(leftMotorB, HIGH);
    }

    if(readString =="R") //Right
    {
        digitalWrite(rightMotorF, LOW);
        digitalWrite(rightMotorB, HIGH);
        digitalWrite(leftMotorF, HIGH);
        digitalWrite(leftMotorB, LOW);
    }

    if(readString =="S") //Stop
    {
        digitalWrite(rightMotorF, LOW );
        digitalWrite(rightMotorB, LOW);
        digitalWrite(leftMotorF, LOW);
        digitalWrite(leftMotorB, LOW);
    }
    readString="";
  }
}
```

6.   Conclusion

The proposed project makes it easier for people, especially the law enforcing agencies, to monitor persons and places. Secret Bot is created very simply and easily so mass production of this robot takes very little time, therefore if one Bot is attacked then another one can be deployed when needed. This way, human lives can be saved in critical situations. As smart mobile devices are readily available to almost everyone, and the Bot can be made smaller, and audio transmission between the Bot and mobile device is possible, the Bot is useful also in many other applications like home surveillance, getting news information from, for example, trapped humans under rubble and in similar conditions.

6.1 Future enhancements

- consolidating the two interfaces in 4.2.2 and 4.2.3 into one dedicated software application which will also incorporate face recognition
- Make the Bot to defuse bombs
- Armor the Bot in order to withstand blasts.
- Allow the Bot to move around on all terrains by adding continuous track plates to the Bot's wheels.

6.2 Hardware and Software Requirements

- Arduino Uno R3   515/-
- L293D Motor Driver   60/-
- IP Camera   2400/-
- Two 600 rpm DC motors
- Breadboard   71/-
- Lithium Polymer Battery 445/-
- Bluetooth Module HC-05 320/-
- Slide Switch
- Wheels   500/-
- Jumper Wire Set   137/-
- Plastic Wood   200/-
- Paper   20/-
- Cycle Spoke   20/-
- One Android device for controlling robot and any other Android/iOS device for viewing footage
- Android 4.0 or up
- Arduino IDE

Total Cost: 4688 Taka only

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