

A Novel RF Robot System Equipped with Wireless Shade Sensor Camera for Enhanced Surveillance

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ABSTRACT

The intention of this paper is to reduce human victims in terrorist attack. So this problem can be overcome by designing the RF based spy robot which involves wireless camera. So that from this we can examine rivals when it required. This robot can quietly enter into enemy area and send us the information via wireless camera. On the other hand one more feature is added in this robot that is color sensor. Color sensor senses the color of surface and according to that robot will change its color. Because of this feature this robot can't easily be detected by enemies. The movement of this robot is wirelessly controlled by a hand held RF transmitter to send commands to the RF receiver mounted on the moving robot

KEYWORDS: RF, spy robot, wireless camera and color sensor.

1. INTRODUCTION

With the aim of developing a high-tech technology that serves high speed technology, advanced capacity to control the robots and to devise new methods of control theory[1]. The realization of above standards some technical improvement along with the need of high performance robot is required to create a faster, reliable, accurate and more intelligent robot which can be devised by advanced control algorithm, robot control devices and new drivers. Earlier the robots were controlled through wired networks but now to make robot more user friendly, they are framed to make user commanded work. Therefore to attain the requirements we can use android as a multimedia to control the user friendly robot [2]. The design of our project encourages developing a robotic vehicle based on RF technology for the remote operation connected with the wireless camera mounted on the robot for monitoring purpose [3].

The robot is embedded with 8051 series microcontroller for desired operation and is generally used for spying purposes. The transmitting module consists of the push buttons that send the commands to the receiving module for controlling the movement of robot either to right, left, forward, downward. In the receiving module of the robot two motors are interfaced with the 8051 series of microcontroller to control its movement via motor driver IC [4]. The remote control (RF transmitter) has a range of 50m that transmits the signals to the RF receiver. The receiver collects and decodes the received signals before feeding it to the microcontroller to drive the DC motors via motor drivers. The wireless camera used for spying purpose also serves in complete darkness using IR lighting [5].

The distinct applications of this concept in such robot can be a smart phone controlled robots where the movement of the robot is controlled by a robot on the basis of android platform. Smart phone transmits the AT commands and data to the 8051 controller and controls the motor by motor driver L923D. The robot motions left, right, forward, backward. Interfacing is being done between device and Bluetooth. Bluetooth device HC-05 module receives the commands from smart phone via 8051 microcontroller. Component technologies used are (a) RF technology (b) C language (c) Embedded system.

2. INTRODUCTION TO EMBEDDED SYSTEMS

The microprocessor-based system is built for controlling a function or range of functions and is not designed to be programmed by the end user in the same way a PC is defined as an embedded system. An embedded system is designed to perform one particular task albeit with different choices and options.

Embedded systems contain processing cores that are either microcontrollers or digital signal processors. Microcontrollers are generally known as "chip", which may itself be packaged with other microcontrollers in a hybrid system of Application Specific Integrated Circuit (ASIC). In general, input always comes from a detector or sensors in more specific word and meanwhile the output goes to the activator which may start or stop the operation of the machine or the operating system [6].

An embedded system is a combination of both hardware and software, each embedded system is unique and the hardware is highly specialized in the application domain. Hardware consists of processors, microcontroller, IR sensors etc. On the other hand, Software is just like a brain of the whole embedded system as this consists of the programming languages used which makes hardware work[7].

As a result, embedded systems programming can be a widely varying experience. An embedded system is combination of computer hardware and software, either fixed incapability or programmable, that is specifically designed for particular kind of application device[8]. Industrial machines, automobiles, medical equipment, vending machines and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system. Embedded systems that are programmable are provided with a programming interface, and embedded systems programming is specialized occupation[9].

Existing system

Unlike most related systems which use remote controllers that communicate with robot. Communicates with robot through Bluetooth signal. This approach is better because Android Devices in the form of smart phones and tablets are very portable and widely used. 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. In the existing system, when the switch of the robot is turned on, the battery powers on the Arduino board which is connected with L293D motor driver and HC-05 Bluetooth module. After pairing the Android device with the module, when the user presses control buttons on the Android application, the corresponding string is transmitted to the module. The module receives the string and the Arduino's microcontroller processes the string for the motor driver to drive the DC motors according to the code uploaded to it.

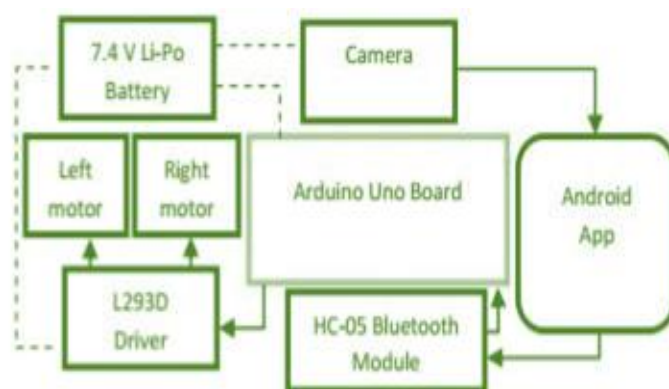


Fig.1 Block Diagram of Existing System

Bluetooth is a short range wireless communication technology that allows devices such as mobiles in a particular range of 2.4 GHz. Exchange the data between fixed distances using short length UHF Radio waves in the industrial, scientific and Medical radio bands, and from 100 meters. It has slow data speeds, poor data security and shortest battery life.

Proposed system

Radio frequency refers to the rate of oscillation of the Electro-magnetic Radio waves range of 30kto 300Ghz. The intention of this paper is to reduce human victims in terrorist attack. So this problem can be overcome by designing the RF based spy robot which involves wireless camera. So that from this we can examine rivals when it required.

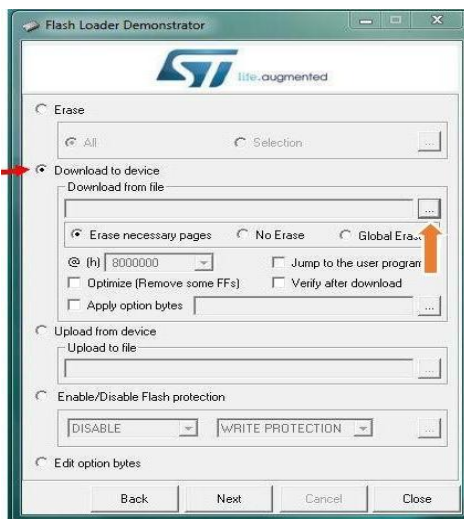
This robot can quietly enter into enemy area and send us the information via wireless camera. On the other hand one more feature is added in this robot that is color sensor. Color sensor senses the color of surface and according to that robot will change its color. Because of this feature this robot can't easily be detected by enemies. The movement of this robot is wirelessly controlled by a hand held RF transmitter to send commands to the RF receiver mounted on the moving robot.

3. SOFTWARE IMPLEMENTATION

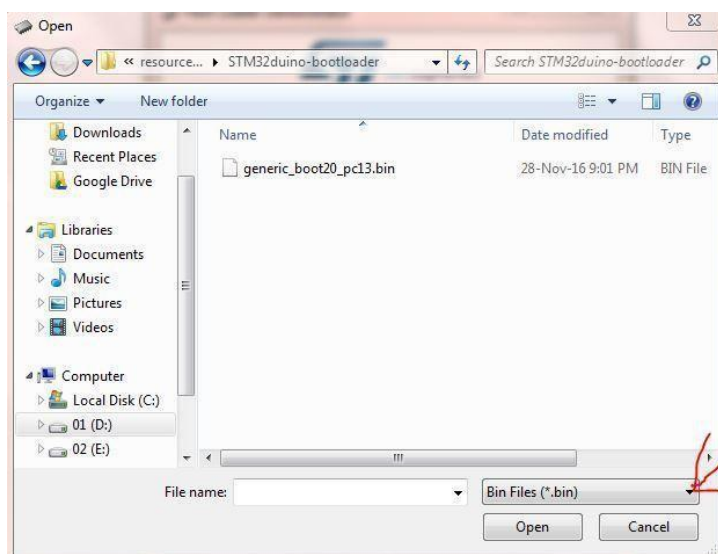
1. Every time before uploading code, connect boot0 to 3V3 and press the reset button
2. When done with code uploading, connect boot0 to GND.

If you don't want to use FTDI to upload code and use the microusb port of the blue Pill board instead, you have to flash a boot loader inside the STM32F103C8T6. By doing so, you don't have to connect boot0 pin to 3v3 for uploading code. And there will be no need to press the RESET button every time before uploading a code.

1. Download demonstrator gui (STM32 flasher) from this link. You have to create a free account to download. Install the software when downloaded.
2. Keep your blue Pill board connected to PC via the FTDI and keep boot0 pin connected to 3V3. Press the **RESET** button.
3. Open STM Flash Loader Demo (demonstrator gui) executable file. Select 115200 Baud rate and select the FTDI COM port. Leave all other settings as default.
4. Press **NEXT** and It will automatically detect the blue pill
5. Press **NEXT** twice and you be at the following window



6. Select download to device and browse (orange arrow) to select **generic_boot20_pc13.bin** file. You will find it under the STM32duino_bootloader folder that you downloaded from media fire.



7. Select Bin Files (red arrow) if the boot loader file doesn't show up. Press **Open**.

8. Press **NEXT** when the boot loader file is loaded and the file will be downloaded to Blue pill board. Close demonstrator gui (STM32 flasher) when done.
9. Open your arduino sketchbook folder. Then open Arduino_STM32 folder>drivers>win and run “install_drivers.bat” as administrator (right click on file, then select run as administrator). Press any key to close when done.
Then run “install_STM_COM_drivers.bat” as administrator, too.
10. Connect boot0 to GND, disconnect FTDI board and connect a microUSB cable (android data cable) to Blue pill. Press the RESET button before connecting to PC.
11. You’ll find windows installing driver for the Blue pill when you connect it to PC using the on board microUSB. Eventually a driver named as “maple DFU” will be installed. You can find it inside windows Device Manager>libusb>maple DFU. Note that there will be no COM port assigned to Blue pill board. That’s normal.
12. Open arduino IDE. Go to Tools>board> Generic STM32F103C Series. Then go to Tools>Variant>STM32F103C8T6 (20k ram, 64k flash). Go to tools> upload method>STM32duino boot loader. Now open the blink code from File>Examples>Basic>blink.
13. Go to tools>port and make sure no port is selected or the port option is deactivated.
14. Hit the upload button. As soon as “**uploading**” message appears at the bottom of arduino IDE, press the **RESET** button of Blue pill board.
15. If your code uploads successfully, you’ll find that windows is installing a new driver and this time it will assign a COM port for your Blue pill board.
16. Go to tools>port and select the correct COM port for Blue pill. The COM port can be found on windows Device Manager> ports (COM & LPT)> Maple Serial (correct port).
17. You have to make sure that the correct COM port is selected to ensure code uploading from now on. The STM32duino boot loader is called perpetual boot loader. It works on DFU mode at first without using any COM port. After the first program is uploaded, it assigns COM port for the computer.
18. You are now ready to use Blue pill board as normal arduino board by using the on board microUSB. Keep Boot0 and Boot1 pin always connected to GND. You don’t have to press RESET button while uploading code anymore.

4. BLOCKDIAGRAM

The below block diagram’s show the transmitter section and Receiver section.

Transmitter section

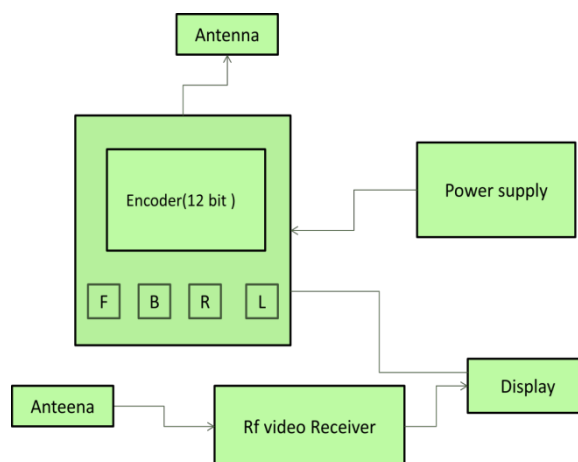


Fig. 2 Block diagram of transmitter

Receiver section

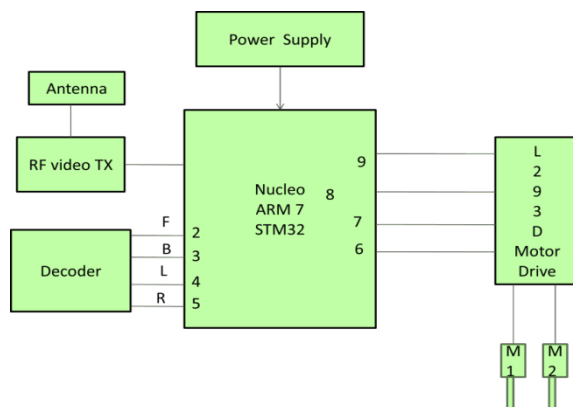


Fig. 3 Block diagram of Receiver

5. 3STM32F103C8T6 BLUE PILL ARDUINO

For beginners it might be difficult to use the popular and cheap blue pill board based on STM32F103C8T6. It's because using an embedded development tools like KEIL isn't easy for beginners. This 32 bit microcontroller based on ARM Cortex-M3 architecture is far better than your traditional arduino board.

You can compare it to Arduino DUE but it has got a very small size like the arduino Nano. There's lack of proper documentation on it and everything available in the internet is quite scattered. So, here's something to get you started easily.

STEPS:

- ✓ First download all the resources from this mediafire link. The password for extracting data from the zip file is: techshopbd.
- ✓ Open resource STM32 bluepill folder. Copy the Arduino_STM32 folder to your sketchbook folder/hardware. Go to arduino IDEs file>preferences and you'll find the location of your sketchbook folder. If there's no hardware folder, create one named as "hardware" (all lowercase letter). Your arduino IDE is now ready for Blue pill.

- ✓ Have a look on the pinout diagram on the next page. There are 2 yellow colored jumpers beside the usb port. They are boot options. Connect boot0 pin to 3V3 and boot1 pin to
- ✓ GND to start the board in SPI mode when it's powered up or the reset button is
- ✓ pressed.
- ✓ Now connect a FTDI board (FT232RL) to blue pill. You can use any of [this](#) or [this](#) or [this](#). Connect FTDI TX to blue pill RX1 (PA10) and FTDI RX to blue pill TX1(PA9).
- ✓ Connect GND. If your FTDI power pin is 5V, connect it to the 5v pin of Blue pill board. If it's 3.3 volt, connect to the pin marked as 3.3. Connecting 5v to any 3.3v pin of Blue pill board will permanently damage it.

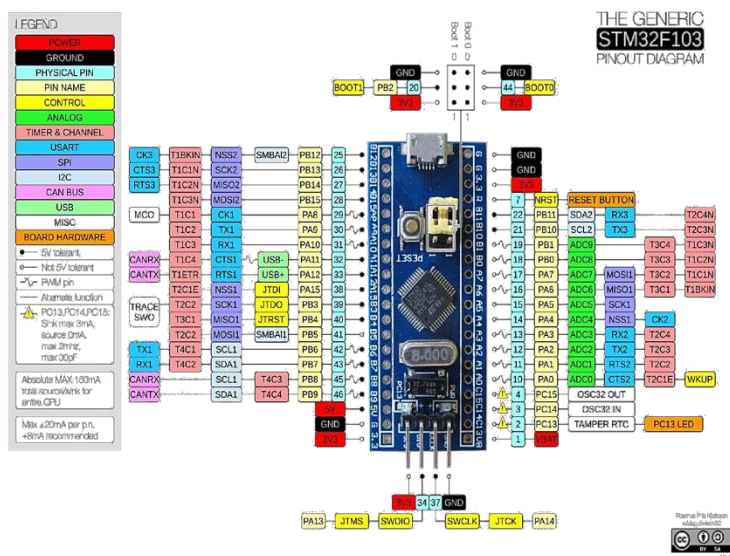


Fig 4: STM32F103 Pinout diagram

- ✓ Connect the FTDI board to your PC using USB port. You must install the FTDI driver to your PC to use the FTDI board. You'll find enough resources on the internet on this. FYI, it's the driver for arduino Nano.
- ✓ close arduino IDE if it's open. Then open it. Go to Tools>board> Generic STM32F103C Series. Then go to Tools>Variant>STM32F103C8T6 (20k ram, 64k flash). These new options for STM32 will be automatically added to arduino if you've performed everything described it **step 2** successfully.
- ✓ Go to tools> upload method>serial. Then tools>port and select the port of the FTDI
- ✓ Go to tools>board> Boards manager and check if "Arduino SAM Boards (32 bit ARM Cortex M3)" is installed or not. If not, select more info and an install button will appear. Install the board definitions. It's necessary because codes for the Blue pill board
- ✓ uses some files written for Arduino Duo for successful compilation
- ✓ Now open the blink code from File>Examples>Basic>blink. Press the reset button on the Blue pill board and hit upload button on the Arduino IDE. (board built-in LED is on PC13)
- ✓ Note that you have to reset the Blue pill board every time you are about to upload code.
- ✓ You will find all other Examples for the Blue pill board under Up button beneath tools option>hardware>Arduino_STM32.

Working procedure

The wireless night vision camera embedded on the robot consists of a wireless transmitter. A cluster of IR LEDs are placed which are used to provide IR light to the image sources. The reason IR light is preferred is because at night time, it is usually dark and since any camera needs light for illumination, infra red light is the most preferred option as all objects emit a range of Infra red light. The camera is powered with a 12 V battery and captures these images and transmits them to the receiver unit connected to a Television unit. The

images are converted to digital signals by the transmitter unit and the receiver unit receives these digital signals and reconverts them to images and these images or videos are then monitored and analyzed on a Television unit.

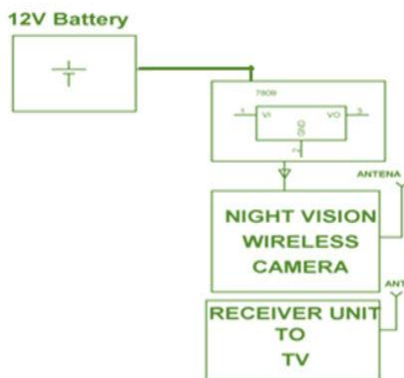


Fig: 5 Block Diagram Showing Basic Working of the Robot with Night Vision Camera

6. CONTROLLING THE WAR FIELD SPYING ROBOT

The transmitter unit consists of an encoder which receives parallel data input from the microcontroller through the push buttons and transmits this parallel data in serial format through the RF module. On pressing the respective push button, Microcontroller is programmed to send relevant signals to the Encoder in parallel form. The encoder converts these parallel signals to serial form to be transmitted by the RF module. This serial data is modulated with a carrier signal using a RF transmitter and is transmitter. For example if we press the left button, the microcontroller sends the command to the receiver unit through the encoder and the RF module.

The receiver unit consists of a RF receiver module which demodulates the received signal and a decoder which receives the serial data through the RF receiver module and converts it into parallel form. The microcontroller uses this data to give appropriate control signal to the motor driver IC to control the operation of the two motors. Thus the robot can be moved forward or in reverse direction by controlling the motor, while the camera does its work simultaneously.

7. RESULT

With the help of this we aimed at obtaining the accuracy. It has been tested to best of our ability. We were able to view the things accurately that were happening. In our view. Our design has not caused any sort of disturbances. This robot will move based on the motor direction depending upon the input we give through command via remote section unit. With the help of camera we are able to view the things that are happening in the war field where the robot is hidden. The importing and exporting features of „AUDACITY“ in this project have helped to remove the unwanted audio signals. By using this software post process all type audio including broadcast by adding effects such as normalizing, trimming fading in and fading out.

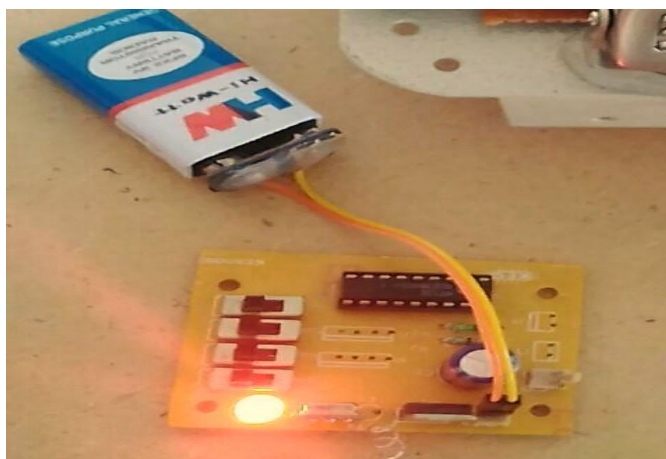


Fig 6: Transmitter section

Above figure consisting of four buttons left, right, forward, backward .we are given left as input encoder encodes the data and send to the receiver. Receiver receives the input and robot moves left. As well as right, backward and frontwards process also same.

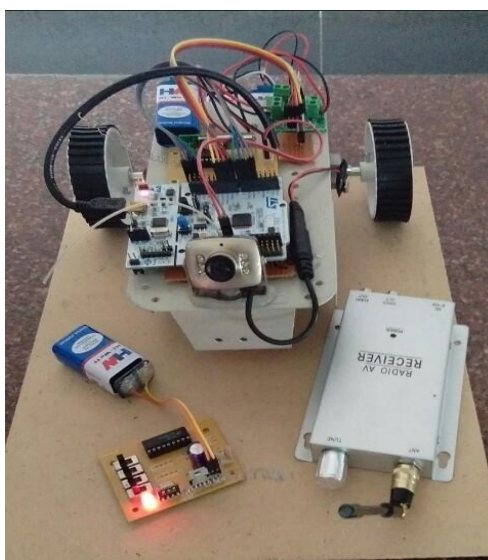


Fig7: Receiver section

Applications

- ❖ The main purpose for designing this robot is that to implement it in defense sector to sense human fetch for it.
- ❖ The sensor with very high frequencies are required to install this robot in the IT industries
- ❖ This robot can be installed in banks, especially in the places where jewels are kept (locker area).
- ❖ In the educational institutions, this robot can play a vital role in the areas of library and laboratory where valuable equipments are kept.
- ❖ Military operations.
- ❖ Surveillance along border.
- ❖ Maneuvering in hazardous environment.

Advantages

- ❖ Code compatibility and expandability across different Nucleo boards
- ❖ Cost is less as Nucleo is open source
- ❖ The schematic of Nucleo is open source. So for future enhancement of the project the board can be extended to add more hardware features

- ❖ Wireless control
- ❖ Takes in use of the mobile technology which is almost available everywhere.
- ❖ This wireless device has no foundation of range and can be controlled as far as network of cell phone.

8. CONCLUSION

The project was come out with the operations of Receiver and transmitter circuit. The functions and the operations of the circuits interrelated are very important to be analyzed. Currently Wireless controlled Omni The main motive of the RF based robot was to make it user friendly. The robot can easily move, capture images and wirelessly transmit them. The robot will move depending on the motor direction based upon the input we give through transmitter (remote) section. RF signals are used as control signals. By using these signals encoding is done & signal is sent through the transmitter. At the receiver end, these decoded signals are given as input to drive the motor. The robot is used for short distance surveillance thus ensuring the security of the region. This helps the forces to view the things accurately that are currently happening in the surrounding area and to plan ahead accordingly. Thus we should be able to manipulate its path when necessary, to create the robot safely directional monitoring robot with video support that can monitor using webcam.

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