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# SECURE WIRELESS COMMUNICATION AND SURVEILLANCE SYSTEM

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## ABSTRACT

*In present days the world has become vulnerable and unprotected from the surrounding environment. Every individual needs their own private protection and surveillance. Taking this point as inspiration, the authors' have designed a surveillance robot which is affordable for both common man and industrialist or whoever it may be. Although existing approaches can achieve a reasonable precision, they rely on fixed narrow band of frequencies which can easily be jammed. In this article, a novel method has been proposed to use Bluetooth using an embedded system to send information to users.*

**Key words:** Bluetooth, Arduino, LCD, L239d, MAX232.

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## 1. INTRODUCTION

Estimating the users who own private protection and surveillance is critical in situations where safety of life is completely dependent on it. Although existing approaches can achieve a reasonable precision, they rely on fixed narrow band of frequencies which can easily be jammed. In this article we propose a method to use Bluetooth using an embedded system to send information to users. Bluetooth uses the technique known as Frequency Hopping Spread Spectrum, which enables the signals to hop from one channel to another using a pseudo random sequence known to both transmitter and receiver 1600 a second, which prevents signal jamming.

## 2. MOTIVATION

When the safety is a concern, private protection and surveillance becomes a prime point for individuals. Often this becomes expensive and unavailable to the common man. This brings

us to our basic motivation of availability of surveillance services at an affordable cost. Taking this point as inspiration, we have designed a surveillance robot which is affordable for both common man and industrialist or whoever it may be. This robot is not only confined for the surveillance, this mechanism can also extended its application to the level of the swarm robotics for remote controlling of number of robot to perform single coordinated action.

### **3. OBJECTIVE**

For surveillance and privacy to be acknowledged, we improvised on controlled movements and display of information to the user. Alongside these two important factors the physical safety of the user is also crucial which can be acquired when the robot system is integrated into a metal armor acting like a protective shield. In the existing system, when a military crew is going for a mission in a desert, the crew uses walky-talky for communication purpose. , the crew needs the meeting point after the mission is completed and they use walky-talky for communication purpose but sometimes communication may be cut-off due to signal jammers used by terrorists.

Thus soldiers find hard to communicate with each other, which results in hindrance of success of the mission. Surveillance systems are all wired or wireless fixed modules. This limits the perspective of surveillance. In our system, the user wearing our module, can get information from the commander and also can be moved by the commander in case of emergency or loss of visual contact with the target. This way the commander can control and instruct all the soldiers together hence assuring no signal disconnect due to jammers.

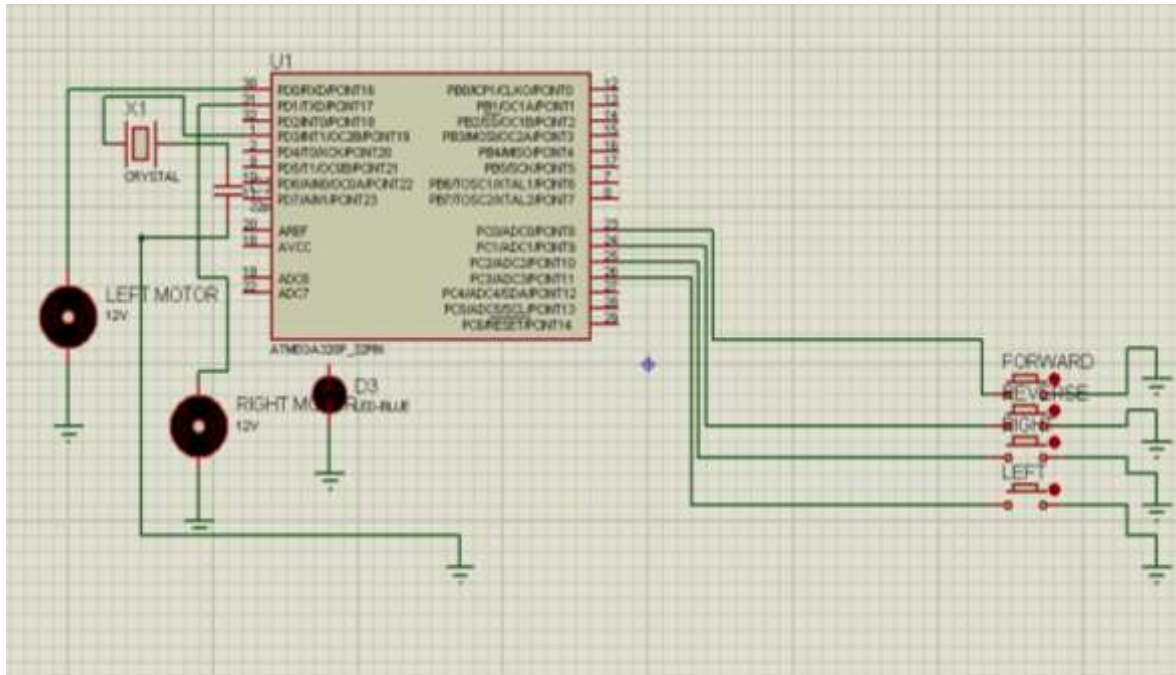
### **4. PROPOSED SOLUTION**

In our system:

- Wireless mode of surveillance which are mobile in condition.
- No auxiliary device required except user existing smartphone for monitoring.
- Controls can be made automotive.

This project describes how to control a robot using mobile through Bluetooth communication, some features about Bluetooth technology, components of the mobile and robot. An open-source platform Android has been widely used in smart phones. Android has complete software package consisting of an operating system, middleware layer and core applications. Android application, Smart phones are becoming each time more powerful and equipped with several accessories that are useful for Robots.

The paper presents a review of robots controlled by mobile phone via moving the robot upward, backward, left and right side by the android application such as Arduino, Bluetooth. Bluetooth has changed how people use digital device at home or office, and has transferred traditional wired digital devices into wireless devices. A host Bluetooth device is capable of communicating with up to seven Bluetooth modules at same time through one link. The paper developed the remote buttons in the android app by which the end users can control the robot motion with them.



**Figure 1** Circuit Diagram

This system will consist of three parts: one mobile application, one hardware device and one skateboard. The mobile application will be used to pass the signals to the hardware module and view information about its movement. While the hardware module is based on Arduino Uno will function as a Robot/Armor which can be controlled and monitored by the application by receiving signals through the Bluetooth module.

The Smartphone device acts as the base hardware on which the Android Application plays the role of an interface. The input is given through the application which is fed to the Arduino board through Bluetooth module which transfers the instructions passed by the smartphone application to the Arduino board. The DC motor is also in synchronization with the microcontroller which makes the robot perform the required kinds of motion.

The mechanical arrangement is provided for movement of the motor which driven through motor driver circuit. The motor driver module is used for driving the motor in the respective direction. The Bluetooth module will act as an interface between Smartphone and the Arduino board. The authors' will be using HC-05 Bluetooth module for the system, which can be used as either master or slave. Generally our master will be smartphone and slave will be Bluetooth module. Bluetooth module will give the commands given by smartphone to the Arduino.

### Arduino Uno/Microcontroller

Prime controller for this robot is Arduino Board which is integrated with MAX232 and HC-05 Bluetooth module. The operating voltage of this robot is 5V-9V and the paper deals with using the regulated DC 5V supply for the control circuit and for the motors DC 9V supply is given And mechanical arrangement is provided for movement of the motor which driven through motor driver circuit. This entire electromechanical arrangement is controlled through remote button of the Android application.

- Arduino is leading microcontroller board which is more flexible and efficient than other.
- Arduino can be easily interfaced with Android.
- Arduino Mega is a microcontroller based on the ATmega328.

- Particularly this board is more compatible with Bluetooth communication (i.e. Serial port communication).

Programming the Arduino:

- Arduino boards are programmed with open source software called Arduino IDE.
- Programming starts with the definition of the input & output pins, reception and transmission of the data.

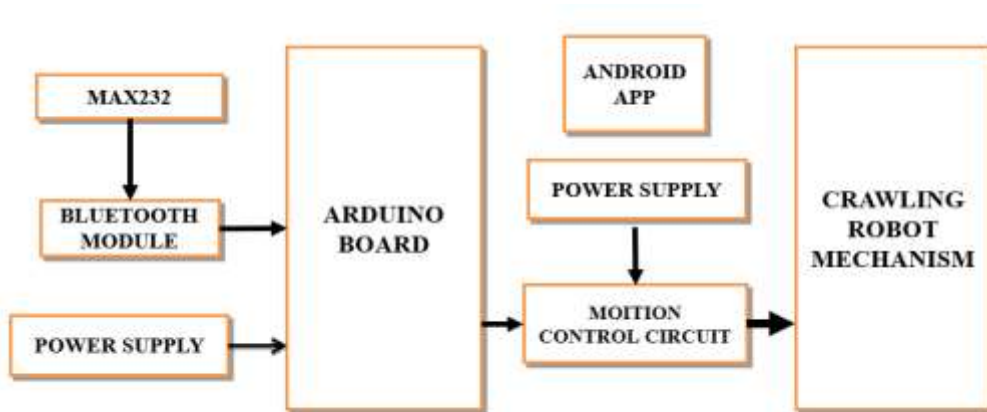


Figure 2 Block Diagram of Module 1

### HC-05 Bluetooth Module

- It consists of the serial Bluetooth interface and Bluetooth adapter.
- It is used to convert the serial port into the Bluetooth data.
- It has two mode master and slave mode, which can be set through the AT command in the Arduino serial communication port.
- It receives the data from the android application and takes it to the Arduino board.



Figure 3 Block Diagram of Module 2

### Decoding the Circuit

- This is used to the **interface** the data transmitted from the Bluetooth module and the Arduino board.
- The data received from the Android application is converted into the serial port data by **decoding circuit**.
- And it is given to the Arduino board for further process.

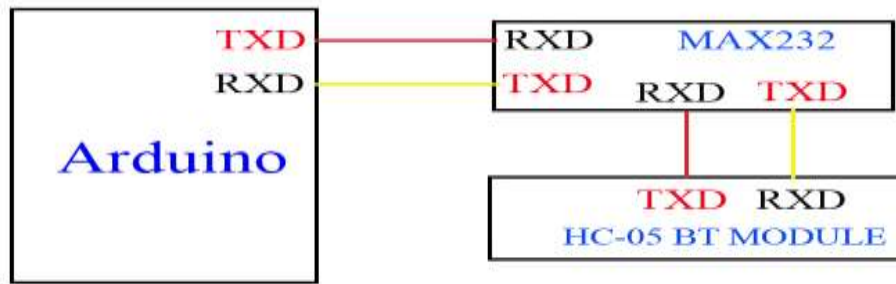


Figure 4 Circuit Block Diagram

## Other Modules

### Android platform software

- Android application is most important feature.
- In this we are using for controlling the motor.
- The motor controlling application is developed from the reference application using MIT app inventor.
- Motor controlling application are integrated with unique code for motion control

The controller has a monitor, the android app and Bluetooth is enabled.



Figure 5 Block diagram of Controller

### Other module

- The motor driver module for driving the motor in the respective direction.
- The voltage regulating module to convert the 12V DC supply into the 5V DC supply.
- Indicating module for the different set of the action.

## Functional Requirements

With the mobile application, the users, in this case the master will be able to control the movements of soldier wearing the armor. The result will be based on the criteria the user inputs. There are various options to control the movement of the armor robot and it will be possible for the user of the application to manage the actions of the robot. The armor is worn by the soldier and is used to pass the commands which benefit the soldier from the dangers that are not visible to him. The system also helps in recognizing the location of various soldiers and helps in communicating among the master and soldiers wearing the armor as it uses Bluetooth to pass the commands, which is not affected by jammers.

There are two types of users that interact with the system: users of the mobile application, users of the hardware module, the armor. Each of these three types of users has different use of the system so each of them has their own requirements. The mobile application users can use the application to control the movement of armor robot. This means that the user have to be able to pass the command to the Arduino through the Bluetooth module. The soldier can wear the hardware module as the armor and perform functions directed by the application user.

### **Non Functional Requirements**

Efficiency (in terms of Time and Space)

- Robot responds to user command within few seconds.
- Robot responds to user's commands at all times.
- The Bluetooth connection is available 100% of the time if in range of 100 meters.
- Robot shall not miss its destination within more than 2 inches.

### **Reliability**

- The Bluetooth connection shall not experience any system major crashes or errors.
- Robot shall not hit any objects in its pathway.
- The Bluetooth connection shall not allow any other slave devices to connect to the master and receive data.
- Robot shall not allow access to its commands to more than one Bluetooth module.

### **Portability**

- Cross-platform - The Arduino software runs on Macintosh OSX, Android, Windows and Linux operating systems. Most of the microcontroller systems are limited to Windows.
- Open source and extensible software - The Arduino software is published as open source tools, available for extension by the experienced programmers. The language can be expanded through the C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it is based.
- Likewise, you have the capacity to add AVR-C code directly into your Arduino programs if you want to.
- Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers. The plans for modules are published under a Creative Commons license, hence experienced circuit designers can create their own version of the module, which can be extended and improved

### **Usability**

- Military robots - These kind of robots includes different transportation robots, bomb disposal robots and reconnaissance drones. Robots initially created for military purposes can be used in search and rescue, law enforcement, and other related fields.
- Medical robots - These are used in medicine and medical institutions. And also in some automated guided vehicles and lifting aides.

### **System Requirement**

#### **ARDUINO UNO**

Arduino Uno is an ATmega328P based microcontroller board. Its specification include: 14 digital input/output pins (of which 6 could be used as PWM outputs pins), an ICSP header, 6

analog inputs, a power jack, a 16 MHz quartz crystal, a USB connection, and a reset button. All the things that are required to support microcontroller; simple connection to any system such as computer, any power source or USB Cable along with a AC-to-DC adapter or battery to get started. Tinkering with UNO without worrying too much about doing something wrong is possible and in the worst case scenario the chip is replaceable for a very small amount.

The word "Uno" means one in Italian which is a reason why it was chosen to mark the release of Arduino Software (IDE) 1.0. A pioneer in the series of USB Arduino boards, Uno is also a reference for the whole Arduino platform. For the detailed list of outdated, current or past boards, Arduino index of boards can be referred.



**Figure 6** Arduino Uno

### ***Programming***

The Arduino/Genuino Uno is programmable with the Arduino Software (IDE). The ATmega328 which is there on the Arduino/Genuino Uno comes pre-programmed with a bootloader which allows new code upload on it, without any external hardware programmer. The communication is done using the original STK500 protocol.

### ***Power***

Power to the Arduino Uno board can be provided through an external power supply or from the USB cable. Automatically, the power source can be selected.

External (non-USB) power can be obtained either from a battery or through an AC-to-DC adapter (wall-wart). The connection to adapter can be done by plugging of a 2.1mm center-positive plug into the power jack of the board. Battery leads moreover can be twitched in the V (in) and GND pin headers of the POWER connector.

External supply of 6-20 volts is needed to operate the board. The board may become unstable incase the supply is less than five volts from the 5V pin. Moreover, the voltage regulator may get overheated if the supply is more than 12V and the board might get damaged. The suggested range of voltage to be supplied should be 7-12 Volts.

### ***Bluetooth***

Bluetooth is specification and a standard for, low-cost, small-form factor, short range radio which links mobile phones, mobile PCs, and other portable devices. In order to transmit data communications and real-time voice, it enables the users to form wireless connections between various communication devices. The Bluetooth radio works in a 2.4GHz band and is put into a small microchip, which is a globally available frequency band which also ensures communication compatibility worldwide. To avoid the interception by other unauthorized

parties, the frequency hopping spread spectrum is used, which changes its signal 1600 times per second. In addition, to ensure the communication amongst only the units that are preset by the owners, identity coding and software coding are built into each microchip.

The specification has two defined power levels: the higher power level has the capability of covering medium range, which could be within one home, and a lower power level which could cover shorter personal area which could be within a room. It supports up to 720 Kbps data transfer in an approximate range of up to 10 meters which could be enhanced to 100 metros with power boost and also enables both point-to-multipoint and point-to-point. The technology can transmit through non-metal barriers and through the walls using the Omni directional radio waves. If there is any interference from any other device, the transmission speed might decrease but won't stop.

Up to almost seven slave devices can be allowed to communicate with one master radio in one single device with the current specifications in the system built. This methodology and connection of devices is termed as. A collection of linked together piconets which form scatter nets are those which enable communication amongst other device configurations.

### ***Decoding Circuit***

This is used to the interface the data transmitted from the Bluetooth module and the Arduino board.

The data received from the Android application is converted into the serial port data by decoding circuit.

And it is given to the Arduino board for further process.

### ***DC Motor***

A DC motor is designed to run on DC electric power. Two pure DC designs examples are Michael Faraday's homopolar motor, which is rare, and the ball bearing motor, which is a novelty.

By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source so they are not purely DC machines in a strict sense.

The authors' in the development have used brushed DC Motor, which will operate in the ratings of 12v DC 0.6A which will drive the flywheels in order to make the robot move.



**Figure 7** DC Motor



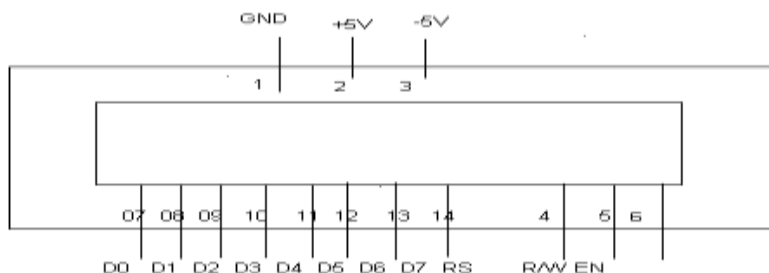
**L239d**

L293D is a general Motor driver or Motor Driver Integrated Circuits which allows DC motor to drive on either direction. To make its use simple, two bridges is pair of channels is presented with an enable input. A distinct supply input is provided to form the logic, which allows the circuit to operate at a low voltage and clamp diodes, which form the internal core are also included.

For frequencies up to 5 KHz, this device is ideal as it can be used in switching applications. The L293D has 4 center pins connected together and is assembled in a 16 lead plastic package. The pins present in the center have their use in heatsinking.

**Liquid Crystal Display (LCD)**

LCD is a type of display used in digital watches and many portable computers. LCD displays utilize to sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. LCD technology has advanced very rapidly since its initial inception over a decade ago for use in lap top computers. Technical achievements has resulted in brighter displace, higher resolutions, reduce response times and cheaper manufacturing process. The liquid crystals can be manipulated through an applied electric voltage so that light is allowed to pass or is blocked. By carefully controlling where and what wavelength (color) of light is allowed to pass, the LCD monitor is able to display images. A backlight provides LCD monitor’s brightness. Over the years many improvements have been made to LCD to help enhance resolution, image, sharpness and response times. One of the latest such advancement is applied to glass during acts as switch allowing control of light at the pixel level, greatly improving LCD’s ability to display small-sized fonts and image clearly. Other advances have allowed LCD’s to greatly reduce liquid crystal cell response times. Response time is basically the amount of time it takes for a pixel to “change colors”, in reality response time is the amount of time it takes a liquid crystal cell to go from being active to inactive.



**Figure 8** PIN Diagram of LCD

**MAX 232**

The MAX232 is a dual driver/receiver which consists of a generator which can generate capacitive voltage to provide RS 232 voltage levels from each 5v supply. Every receiver alters RS-232 to 5v TTL/CMOS levels. Every driver alters TLL/CMOS input levels into EIA-232 levels. The controller pins P3\_0 (RX) and P3\_1 (TX) are chained to the max 232 driver and the TX and RX pin of max 232 is chained to the Computer or GSM modem.

In this circuit the microcontroller transmitter pin is connected in the MAX232 T2IN pin which alters input 5v TTL/CMOS level to RS232 level. Then T2OUT pin is connected to reviver pin of 9 pin D type serial connector which is directly connected to PC.

In our application the data which is to be transmitted is passed to the R2IN of MAX232 via the transmitting pin of 9 pin D type connector which alters the RS232 level to 5v TTL/CMOS level. The R2OUT pin is chained to receiver pin of the Arduino. Similarly the data is transferred between the Arduino and application.

### **Buzzer**

A buzzer or beeper is a device which is used to pass audio signals, it may be mechanical, electromechanical, or piezoelectric. Common uses of beepers and buzzers are alarm devices, timers and realization of user input such as a touching the phone's screen, mouse click or keystroke. Electromechanical. Before devices were based on an electromechanical system identical to an electric bell, but without the metal piece. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were attached to a wall to use them as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

## **5. FUTURE SCOPE**

One of the vital operations of robot controller is that it should not modify the hardware if anything goes wrong. One dependency about the product is that the hardware module doesn't have a lot of SRAM or flash memory that limits the kinds of programs you can load on the chip. This system can be further developed by adding more features and by enhancing the performance. In Military and Special Forces, the armor can be modified and various use cases can be added which may further enhance the safety of soldiers. On further improvements, this robot is not only confined for the surveillance, this mechanism can also extend its application to the level of the swarm robotics for remote controlling of number of robot to perform single coordinated action.

## **6. CONCLUSIONS**

The Wireless control is one of the most important basic needs for all the people all over the world. But unfortunately the technology is not fully utilized due to a huge amount of data and communication overheads. Generally many of the wireless controlled robots use RF modules. But our project for robotic control makes use of Android mobile phone which is very cheap and easily available. The available control commands are more than RF modules. For this purpose the android mobile user has to install a designed application on her/his mobile. Then he/she needs to turn on the Bluetooth in their mobile. The wireless communication techniques used to control the robot is nothing than Bluetooth technology. User can use several commands like move reverse, forward, move left, move right using these commands which are given from the Android mobile. Robot has a Bluetooth receiver unit that receives the commands and move left, move right using these commands which are given from the Android mobile and send it to the Arduino circuit to control the motors. The Arduino UNO then transfers the signal to the motor driver IC's to operate the motors.

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