

# *Novel Approach to Design an Unbounded Surveillance Robot for Security System*

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## **Abstract**

*The basic idea of the proposed surveillance robot prototype is to respond to the need for an autonomous home security system, not limited to a particular location and accessible from anywhere in the world, which has a mobile network. Today, Home security systems require many expensive components and complex installation processes. Currently the main systems are cable systems. The disadvantage of these cable systems is that they are time consuming and expensive to install. Another drawback is the permanent part of the house where the security system is installed. If the homeowner moves from home, he has no access to the security system. As a result, we are thought of building an infinite range wireless robot that is mobile and capable of controlling the home security and having easy access to it from anywhere in the world. The purpose of the proposed system should be to eliminate the deficiencies of the cabling system. The robots will become a unit that will monitor the house for various dangerous situations and respond to videos through a web interface with an Android application.*

**Keywords:** - DTMF Module, Arduino UNO, Motor Driver, DC Motors, IP Webcam, Ivideon.

## **INTRODUCTION**

The aim of this paper is to make a self-contained home security system, which will not be confined to a particular place and can be accessed from any part of the world, having a mobile network. Currently, home security systems require high-cost components and a complicated installation process. The main type of system currently available are wired systems. The drawback of these systems are the installation of such systems are expensive. Another disadvantage is that it is a permanent part of the home. If the owner moves out of his house, he has no access to the system. As a result, we thought of making a wireless, infinite range robot, which will be movable and can keep a check of our house and at the same time we shall have easy access to it, from any part in the world. The aim of the proposed system is to eliminate the shortcomings of wired systems. The robot has a single unit that monitors the home for various hazardous conditions and provides video feedback through a web interface. Real-Time monitoring and capturing using a camera. Many researches has carried out navigational procedures and circuitry system of surveillance robots [1-4]. Some innovative research has also successfully

carried out. The wired or wireless controlled robot existing presently turns out to be exceptionally bulky and it likewise will be confined to a fixed area. The traditional indoor security system uses some monitoring devices like video cameras mounted on the wall at multiple places. It increases the cost of an indoor security system. These systems with multiple cameras are much costly and complicated to install and use it. They are not flexible to implement a monitoring system in an indoor security system. Now a days, various authors discuss about various aspects of different types of observing activities and tracing applications which are being reported by several researchers. Such as J. Azeta, C. A. Bolu, D. Hinv, A. A. Abioye, P. Onwordi has developed a sustainable surveillance robot that is cost-effective using an Arduino microcontroller together with a motor shield and an Android smartphone that runs the Operating System [5]. Hailong Huang, Andrey V. Savkin has considered deploying a flying robotic network to monitor mobile targets in an area of interest for a specific time period [6]. Payam Shafiei Gohari, Hossein Mohammadi, Sajjad Taghvaei has shown chaotic maps to be suitable for applications that require

unpredictable behavior. The chaotic maps are used for motion planning and control of a quadrotor for boundary surveillance purposes[7].Henrik Carlsen, Linda Johansson, Per Wikman-Svahn, Karl Henrik Dreborg has developed different evolutionary paths, opportunities, threats and ethical aspects that are identified with the introduction of robotics in the home security sector using an iterative methodology of participatory seminars [8]. K. Schilling, F. Driewer has addressed specific aspects of the teleoperator to remotely control the robots [9]. Khaled Sailan, Ing. Klaus-Dieter Kuhnert has shown how by using a fuzzy controller an obstacle can be avoided for amphibious autonomous vehicles [10].Gašparík Marek, Šolek Peter has designed a robot with the function of the security system in the home. The robot can be controlled by mobile phone using DTMF or hobby RC system [11]. Francesco Capezio, Fulvio Mastrogiovanni, Antonio Sgorbissa, Renato Zaccaria has proposed a mobile robot for autonomous surveillance in civilian airports and similar wide outdoor areas[12]. Mohd Anuar Mat Isa, Habibah Hashim, Jamalul-lail Ab Manan, RamlanMahmod, Lukman Adnan has proposed new security system architecture using the concept of unified security, trust and privacy (STP) framework for surveillance activities in cloud computing [13]. N. M. H. Norsahperi, M. A. Abdullah, S. Ahmad, S. F. Toha, I. A. Mahmood has proposed Spherical rolling mechanisms (SRMs) which exhibits several advantages with respect to wheeled and legged mechanisms. In fact if the SRM is combined with the power of the bouncing mechanism, it will produce exciting phenomena that can be contributed [14] this application designed an Arduino-based robot that uses Bluetooth technology to control the robot and a Wi-Fi network to stream video.

### Motivation:

In the last five years, the number of homes with home security systems has increased by about 40%. Today, almost every homeowner has invested in electronic- security device. However, a very high proportion of these homeowners are not satisfied with their service providers and expect more from them. High cost and poor service to the customers are the main reasons many consumers give as the reason for their dissatisfaction. Also, there are monitoring costs, which can be just as expensive, typically about Rs.1500 to Rs.3500 in a month. Not only sound education but his alertness and dedication too are most required. Only professional installation of the system is required and can be costly. To upgrade the auditor, it is difficult to remove and reinstall the system cable.

So, the basic principle behind the concept of the device is to create a device as a suitable replacement for the enduring domestic security system. This system is simple, reliable, and inexpensive.



Figure 1: Arduino UNO

### DC Motor:

A DC motor is a class of rotating electric machine that converts electrical energy directly from current to mechanical energy. The most common type depends on the force produced by the magnetic field. Almost all types of DC motors have some internal mechanism, whether electrically or electronically, to periodically change the direction of current flow in the motor part. Figure 2 shows the illustrated figure of a DC motor.

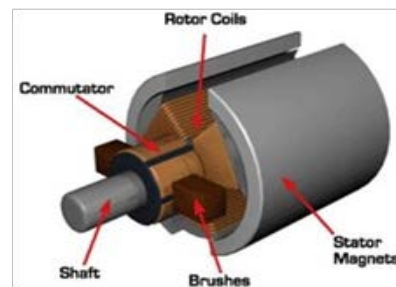


Figure 2: Different component of DC Motor  
(Source: Google image)

### DTMF Module:

DTMF is a Dual Tone Multiple Frequency decoder module that decode DTMF tone signal to digital signal that are acceptable for arduino Uno. Here, an AUX cable is needed for connecting the DTMF module to the phone. Figure 3 shows the DTMF decoder module. Frequencies used (in Hz) are 697, 770, 852, 941, 1209, 1336, 1477 and 1633.



Figure 3: DTMF decoder Module (Source: Google images)

**Motor Driver:**

It is a standard driver unit that allows the motor to run smoothly in any direction. It has a 16-pin IC that simultaneously controls a set of two DC motors on each side. This means that two DC motors can be controlled with one IC. Figure 4 shows the motor driver module which is used in this proposed system to drive the wheels of the surveillance robot through the DC motor.



Figure 4: Motor Driver (Source: Google images)

**Robot Chassis with wheels:**

A chassis consist of an internal-frame that supports a man-made object. It is analogous to the skeleton of an animal. An example of a chassis is the underside of a motor vehicle, which consists of the frame (on which the body is mounted) with the wheels and machinery. Figure 5 shows the chassis of the surveillance robot.



Figure 5: Robot Chassis with wheels (Source: Google images)

**Methodology and Working Principle**

First, we will call the transportable or mobile phone which is placed on the robot. The transportable will receive the decision as an auto-answer mode. Then we will open the dial pad of our transportable, and press different numbers to supply tones of various frequencies. The transportable placed within the car is connected to the DTMF decoder module using an AUX cable. After converting the tones into the binary combination, they are sent to the Arduino UNO through the DTMF module as input. After that, the motor driver is connected to Arduino UNO as output. The motor driver allows us to manage the motor connected to the wheels of the car. Then the various numbers give us the subsequent movement. The video footage is then retrieved with the help of an android application that connects the mobile, present within the robot with

a laptop, which allows us to induce the total display of place through the online. Figure 6 shows the block diagram representation of the proposed prototype surveillance robot. Table 1 represents the movement of the surveillance robot by using of mobile and DTMF module. Figure 7 shows the working flow chart of the proposed prototype surveillance robot. Figure 8 shows the details circuit diagram of the proposed surveillance robot.



Figure 6: Block diagram of the proposed system

Table 1: Table for movement of the surveillance System

Control Keys	Car Direction
2	Forward
4	Left
6	Right
8	Backward
5	Stop
1,3,7,9,#,0,*	Not Assigned

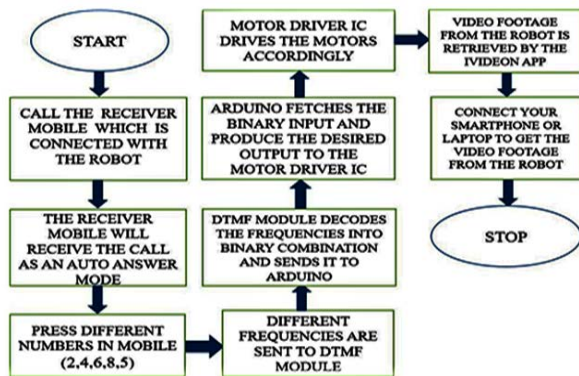
**Remote section:** In this section, the main component is the DTMF module. Here we get a tone from our cell phone using AUX wire to DTMF Decoder IC MT8870 which decodes the tone into a digital signal of 4bit.

**Control Section:** Arduino reads the sented DTMF Decoder commands and it compares with defining code or pattern. If commands is match then Arduino send the respective command to the motor driver section.

**Driver section:** The driver section consists of a motor driver as well as two DC motors. The motor driver is used for driving motors because Arduino does not supply sufficient voltage and current to the motor. So we add a motor driver circuit to get sufficient voltage and current to the motor. Then collect commands from Arduino, motor driver drives, motor according to commands.

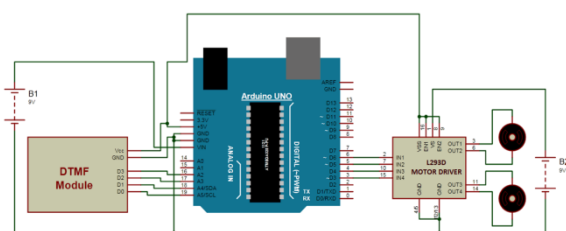
**Video retrieval section:** The video footage is retrieved by the help of an android application that connects the mobile present in the robot with a

laptop or PC, which allows us to get the full display of place through a web interface.



**Figure 7: Flowchart of the whole proposed model**

**IP Webcam and IVEON:** IP Webcam is an android camera application which has to be installed in the receiving mobile phone. This app does not require any premium for its operation and it is available completely free in the play store. For the surveillance purpose, we will begin serving video streaming on the receiving phone. IP Webcam and IVEON application must be signed in with the same email ID for its operation. After that, we will open the www.iveon.com in any web browser from the laptop that is present with us. We can take pictures as well as record videos. Also, there are many features such as switching the back camera to the front camera, glowing the led torch and many more. We will be able to get live video streaming from the robot placed at any distance using the internet or wireless fidelity.



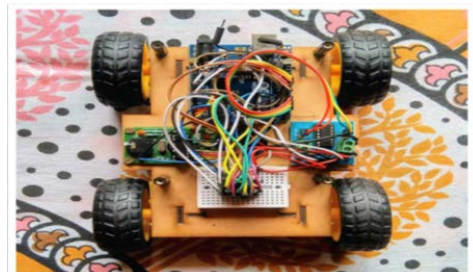
**Figure 8: Circuit Diagram of the proposed model**

**RESULT AND DISCUSSION**

Our practice model is completely ready for surveillance and we are successful in making the proposed idea for practical implementation. So far everything is working fine as discussed. The robot moves forward, backward, left and right by pressing the following keys 2, 8, 4 and 6 from the mobile phone respectively and 5 stops the robot. The video feed is further obtained by using IP Webcam and IVEON application which is free of cost and independent of monthly charges.

The video which we obtain is pretty clear, but during movement, the video feed which we obtain

has a certain delay when we are using an internet connection. In the case of local Wi-Fi, the delay is decreased and we are further trying to limit the delay in the video. In comparison to other existing projects, our model provides better results and is relatively inexpensive as it uses a second-hand mobile phone instead of a camera, which is an E-waste. We have not used a camera and a Wi-Fi module for the surveillance part because it was turning out to be much expensive and also the video was gloomy as it uses VGA (video graphics array) camera for its operation. So, for this purpose, we have used an old mobile phone instead, which has a better 8mp camera and will provide better video quality. Figure 9 show the snap short of the proposed prototype surveillance robot and figure 10 shows the snapshot of the proposed prototype surveillance robot.



**Figure 9: Snapshot of Circuit Connection of the surveillance robot**

**Few advantages over other existing systems:**

- This robot can be controlled from any part of the world.
- This robot will be very lightweight and relatively inexpensive.
- This robot will be able to navigate in various types of floors in modern homes.
- This robot can be very easily controllable by the user.
- This robot requires- time investment and no monthly charges are charged.
- This robot will be secure and only the owner will have access to it.
- This robot will be capable of transmitting real-time data over the web.

**CONCLUSION AND FUTURE SCOPE:**

The surveillance robot will be designed to offer a reasonable level of efficiency as well as simplicity. The surveillance robot can be customized to perfectly integrate into any home, apartment or multiplex unit. Based on modular designs and full scalability, the surveillance robot is designed to be expandable and allow future updates of home

control, thus improving the protection of our home with the change of time and lifestyle.

This proposed system is far-reaching in many places and can always find room for improvement. A big disadvantage of this robot is the fixed potential of the battery used for the robot's movement. After working 6-7 hours straight, you can see that the battery is starting to drain. For this purpose, we can use a mini solar panel, which will continuously power the battery, as well as the receiving cell phone that will help us move the robot efficiently day after day for surveillance, without changing the battery. In addition, this project can be implemented in climbing robots, hovercraft and flying drones with detailed functionality, it is the proposed future work of this application.

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