SPY Night Vision Robot with Moving Wireless Video Camera & Ultrasonic Sensor

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Abstract

It is unique spy robot circuit which can be controlled by using a computer system from its keyboard. It can act as a live telecast of audio and video information from the surroundings and can be sent to a remote station through RF signals & also able to access information when surrounding have darkness because its include extra circuitry arrangement which detect darkness and automatically switch on its flash light. Moment of camera is also possible just by specific key command from the keyboard. The maximum range is 200 meters. Another feature included it measure the distance of object at front of robot and also automatically stop robot if its detect distance of object is inside 10cm & data of distance can be also access at remote section unit by send RF signal. It overcomes the limited range of infrared remote controllers. The circuit uses RF modulator, two RF modulator is used it is Trans receiver. So RF 2.4GHz ASK transmitter and receiver are used for the remote control which provide serially communication under specific range. H-bridge circuits are used for driving motors of base & relay board is used for drive motor of camera arm moment. Two 12V DC/60RPM gear motors are used as drivers & Two 12V DC/10RPM gear motors are used as camera arm. In this paper we are using a wireless video camera. It works on 12V DC supply. The 12 Volt DC supply is taken from the battery placed on the robot. The camera has a receiver, which is placed in the remote station. Its output signals are in the form of audio and video. These signals are directly connected to a TV receiver or a computer through a tuner card.

Keywords: Ultrasonic sensor, ASK, LDR, Robot Arm and RF modulator etc...

1. INTRODUCTION

Our paper is based on domain embedded system and Robotics. An embedded system is a computer system with a dedicated function for specific task in which microcontroller programming is used, often real time constrains. Microcontroller chip is as a system on a chip which contains a little amount of inbuilt RAM, ROM, Flash memory itself. A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. A Robot is a mechatronics’ device which also in includes resourcefulness or autonomy. A device with autonomy does its thing “on its own” without a human directly guiding it moment-by-moment Robotics is a confluence science using the continuing advancements of mechanical engineering, material science, sensor fabrication, manufacturing techniques, and advanced algorithms. The study and practice of robotics will expose a dabbler or professional to hundreds of different avenues of study. For some, the romanticism of robotics brings forth an almost magical curiosity of the world leading to creation of amazing machines. A journey of a lifetime waits in robotics. Robotics can be defined as the science or study of the technology primarily associated with design, fabrication, theory, and application of robots. While other fields contribute the mathematics, the techniques, and the components, robotics creates the magical end product. The practical applications of robot drive development of robotics and drive advancements in other sciences in turn. Crafters and researchers in robotics study more than just robotics. Robot control using RF is an exclusive paper where the direction of the movement of robot can be changed using wireless technologies. The robot will be placed different from that of from where it is controlled the robot movement is controlled using wireless concept in this paper; the robot movement is controlled by using remote controller in a wireless fashion. This paper can also be carried out using wiring processes. But the main disadvantage when we go for wiring is that, data transmission and reception may not be perfect and the data may be lost if the wiring is not done properly. Thus, the robot movement is controlled using wireless concept in this paper. In this paper, the robot movement is controlled by using remote controller and the information will be passed to the robot in a wireless fashion.

1.1 Need for remote operated spy robot

The idea of the paper evolved with a fantasy to see the places we wish to see at will. In this paper this idea is realized at our fingertips. The paper is done to create a version of spying robot that can enable us to observe the place of our interest. The size of the robot also aids it to be used as a spy robot. Thus to create the robot, we should be able to manipulate its path when necessary. To realize all that, a control unit is required. In this control units RF signal is used. Using these signals encoding is done and signal is sent through the transmitter. In the receiver end these received signals are decoded and given as input to drive the motor. This will help us to manipulate the robot in the manner we want. A video transmitter mounted on top of the robot helps us to see the path of motion.
2. GENERAL DESCRIPTION

Radio frequency (RF) is a frequency of rate of oscillation in the range of about 3 KHZ to 300 GHZ which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. Since most of this range is beyond the vibration rate that most mechanical system can respond to, RF usually refers to oscillations in electrical circuits or electromagnetic radiation. Electrical currents that oscillate at radio frequencies have special properties not shared by direct current signals. One such property is the ease with which it can ionize air to create a conductive path through air. This property is exploited by “high frequency” units used in electric arc welding. Another property is the ability to appear to flow through paths that contain insulating material like the dielectric insulator of a capacitor. The degree of effect of these properties depends on the frequency of the signals.

2.1 Brief description of RF

Radio frequency is a term that refers to alternating current (AC) having characteristics such that, if the current is input to an antenna, an electromagnetic (EM) field is generated suitable for wireless broadcasting and/or communications. These frequencies cover a significant portion of the electromagnetic radiation spectrum, extending from 9 KHZ, the lowest allocated wireless communications frequency (it’s within the range of human hearing), to thousands of gigahertz (GHz). When an RF current is supplied to an antenna, it gives rise to an electromagnetic field that propagates through space. This field is sometimes called an RF field: in less technical jargon it is a “radio wave”. Any RF field has a wavelength that is inversely proportional to the frequency. In the atmosphere or in outer spaces, if F is the frequency in MHz and the wavelength in meters, then \( \lambda = \frac{300}{F} \). The frequency of an RF signal is inversely proportional to the wavelength of the EM field to which it corresponds. At 9 KHZ, the free-space wavelength is approximately 33 kilometers (km) or 21 miles (mi). At the highest radio frequencies, the EM wavelengths measure approximately one millimeter (1mm). As the frequency is increased beyond that of the RF spectrum, EM energy takes the form of infrared (IR), visible, ultraviolet (UV), X rays, and gamma rays. Many types of wireless devices make use of RF fields. Cordless and cellular telephone, radio and television broadcast stations, satellite communications systems, and two-way radio services all operate in the RF spectrum. Some wireless devices operate at IR or visible-light frequencies, whose electromagnetic wavelengths are shorter than those of RF fields. Examples include most television-set remote-control boxes some cordless computer keyboards and mice, and a few wireless hi-fi stereo headsets. The RF spectrum is divided into several ranges, or bands. With the exception of the lowest-frequency segment, each band represents an increase of frequency corresponding to an order of magnitude (power of 10). The table depicts the eight bands in the RF spectrum, showing frequency and bandwidth ranges. The SHF and EHF bands are often referred to as the microwave spectrum.

RF Advantages:
- No line of sight is needed.
- Not blocked by common materials. It can penetrate most solids and pass through walls.
- Longer range
- It is not sensitive to the light
- It is not much sensitive to the environmental changes and weather conditions

2.2 About Ultrasonic Sensor

The human ear can hear sound frequency around 20HZ ~ 20KHZ, and ultrasonic is the sound wave beyond the human ability of 20KHZ. Ultrasonic transmitter emitted an ultrasonic wave in one direction, and started timing when it launched. Ultrasonic spread in the air, and would return immediately when it encountered obstacles on the way. At last, the ultrasonic receiver would stop timing when it received the reflected wave. As Ultrasonic spread velocity is 340m/s in the air, based on the timer record t, we can calculate the distance (s) between the obstacle and transmitter, namely: \( s = \frac{340t}{2} \), which is so-called time difference distance measurement principle. The principle of ultrasonic distance measurement used the already-known air spreading velocity, measuring the time from launch to reflection when it encountered obstacle, and then calculate the distance between the transmitter and the obstacle according to the time and the velocity. Thus, the principle of ultrasonic distance measurement is the same with radar. Distance Measurement formula is expressed as: \( L = C \times T \) In the formula, \( L \) is the measured distance, and \( C \) is the ultrasonic spreading velocity in air, also, \( T \) represents time (T is half the time value from transmitting to receiving ). Ultrasonic ranging module HC-SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.

2.3 About photo resistor

A photo resistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. A photo resistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as a few mega ohms (M\( \Omega \)), while in the light, a photo resistor can have a resistance as low as a few hundred ohms.
2.4 Wireless Camera Receiver

We are using a wireless CCD camera, this type of cameras are commonly available in the market. This camera works on 12volts DC supply. The camera has a receiver, which is placed in the remote station. Its output signals are in the form of audio and video. These signals are directly connected to a television or a computer through a tuner card. This CCD camera is connected to the robot. This camera captures the video and audio signals and sends those signals to the remote station and with the help of the camera receiver which is connected to the television or a computer through we can able to see the captured signals.

3. WORKING

When we are pressing any key in remote controller section by keyboard on the window of Aurdino IDE for command to robot, firstly it command to the robot the signal is converted into machine language by aurdino board through USB port represent as a CMOS logic. Now signal from aurdino board is converted into radio frequency signal by RF module. RF modem send data serially by means of 2.4GHz. At the Remote Section, signal is received form the RF module in form of the Radio frequency and it convert to binary. From RF module signal is transmitted to Microcontroller. By microcontroller it makes a decision according to command which is defined in programming. If command for operate camera arm or drive motor so the output signals that are generated controls the H-bridge/relay board which then rotates the motors. Ultrasonic sensor detect the distance and data send to
microcontroller, output control signal generated as per decision of microcontroller & display on LCD (16x2) & also display on LCD monitor. LDR detect the light, using microcontroller makes decision either flash light is On or Off. The transmitter accepts both linear and digital inputs and can operate from 1.5 to 12 Volts-DC. The receiver operates from 4.5 to 5.5 volts-DC. Video Transmission Section: In this paper we are using a wireless CCD camera. Now these types of cameras are commonly available in the market. It works on 12VDC supply. The 12 Volt DC supply is taken from the battery placed in the robot. The camera has a receiver, which is placed in the remote station. Its output signals are in the form of audio and video. These signals are directly connected to a TV receiver or a computer through a tuner card.

4. RESULT

During tests, our design works as expected. The primary metric for our paper would be accuracy. This has been tested to the best of our ability. We have been able to view the things accurately that are happening. In our experience, our design has not caused any sort of disturbances. The robot will move based on the motor direction depending upon the input we give through command by remote section unit. With help of interfacing LCD (16x2) it display the current operation is going on as example left robot, camera up, near to object. It displayed at the second row and show distance at the first row. With the help of the camera we are able to view the things that are happening in the area where the robot is hidden. By keeping the circuit simple, most users will be able to use it easily.

![Fig -3: Robot platform: moment of camera and base for motion of robot](image)

Table -1: Function of ROBOT

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Press key from keyboard</th>
<th>Function of ROBOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0</td>
<td>For stop camera</td>
</tr>
<tr>
<td>2.</td>
<td>5</td>
<td>For camera up</td>
</tr>
<tr>
<td>3.</td>
<td>2</td>
<td>For camera down</td>
</tr>
<tr>
<td>4.</td>
<td>3</td>
<td>For camera right</td>
</tr>
<tr>
<td>5.</td>
<td>1</td>
<td>For camera left</td>
</tr>
<tr>
<td>6.</td>
<td>w</td>
<td>For forward robot</td>
</tr>
<tr>
<td>7.</td>
<td>s</td>
<td>For backward robot</td>
</tr>
<tr>
<td>8.</td>
<td>a</td>
<td>For right robot</td>
</tr>
<tr>
<td>9.</td>
<td>d</td>
<td>For left robot</td>
</tr>
</tbody>
</table>

Table -1 represent the function of the robot, by using the computer keyboard the robot is operated by specific key for specific function as according to program burned in the microcontroller. Instead of using keyboard command to the Arduino IDE, a specific software can be designed with the help of GUI as example visual studio or MATLAB, and other software. Manual Remote is also design for give instruction to Robot but it need a display unit which represent the signal from camera and also speaker for sound. LCD (16x2) also require for display the current operation and obstacle distance. Figure 3 represent the motion of robot and also movement of the camera Arm. The original view are shown in figure-4.
CONCLUSION

The idea of the paper evolved with a fantasy to see the places we wish to see at will. In this paper this idea is realized at our fingertips. The paper is done to create a version of spying robot that can enable us to observe the place of our interest. The size of the robot also aids it to be used as a spy robot. Thus to create the robot, we should be able to manipulate its path when necessary. To realize all that, a control unit is required. In this control units RF signal is used. Using these signals encoding is done and signal is sent through the transmitter. In the receiver end these received signals are decoded and given as input to drive the motor. This will help us to manipulate the robot in the manner we want. A video transmitter mounted on top of the robot helps us to see the path of motion. The reason behind manual control of the robot is that it will not be lost owing to absence of human involvement. If not for long range applications it can be used as a spy robot within short distances.

The paper is used to demonstrate the following favorable results:

- Robot as a live telecast
- Robot as a Night vision
- Robot as obstacle detector
- Robot as distance measurement

This circuit is not much complex and feasible for all beginners. The analysis one to learn what their roles and their values play in a circuit. Such analysis provides a reader a step in point towards improving or customizing the circuit. Integrating features of all the hardware components used have developed it. This paper has given us a scope to understand the conceptual knowledge about RF transmission. It helped us to acquire great sense of practical knowledge finally we would like to thank one and all who helped us in the field.

FUTURE IMPLEMENTATION

1) In this system we can use zig bee+ Wi-Fi, so we can connect the system directly to the internet. Through the internet we can control the system via remote location.
2) By implementing SD-Card Recording can be done, as well as work as CC-TV camera.
3) No requirement of Simulation tool by using GUI software.
4) Halogen light is used for vision of the robot
5) By using voice recognition system we also control the project on commanding in our voice.
6) On implementing Microprocessor programming we also used it as automatically controlled robot or a vehicle.
7) Easily operated by Cellphones by implementing DTMF system.
8) Wireless manual remote can be implement.
9) Android Apps can be easily developed for operate these robot
10) By implementing GPS system, the detection of robot can be easily determined
11) By implementing RFID system, These play a major role in security systems and save database
12) Implement internally power system i.e. main power to operate robot from computer system by pressing specific key by keyboard as well as manually can be operate.
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