Defence Surveillance Robot Based On RF and DTMF Technology

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ABSTRACT: Robots play a major role in many walks of life and are extensively used in the areas of defence, industries, medical and home applications. They can carry out different risky jobs that cannot be done by human. This paper presents Defence Surveillance robot (DSR) for defence purpose that has metal and magnetic field detection sensor, LDR sensor for night vision, fire detection sensor with pump motor to extinguish fire, IR sensors for path finding and obstacle avoidance, moisture sensor. A robotic arm of 4 degree of freedom is interfaced for explosive placement and diffusion. The system provides continuous visual monitoring through the wireless camera attached to the robot and sends continuous data to the control unit. Basically three modes of operations are provided i.e. RF mode, DTMF mode and Automatic mode.

KEYWORDS: RF transmitter and receiver, Camera, Robots, DTMF, Defence surveillance.

I. INTRODUCTION

Necessities are the mother of inventions. Whenever Human being finds the need of something it will lead to a wonderful invention. After the 26/11 attack Taj hotel in Mumbai, All country started focusing on how to control the attack of terrorism and how to improve the security to a nation. As a result some nations started using of robots in the defence field. Since tracking of enemies at far areas is much difficult for spies. There is a possibility of loss of life in the war. So our idea is to replace the human with the robot. Hence, today is the era of revolution in the field of robotics [1].

The implementation of this project is to resolve the problem of replacing a human army with wireless controlled Omni directional monitoring robot with video support that completely controlled with wireless network. The project is to detect an object that is located at some distance within the range of RF transmitter with wireless camera. This vehicle is equipped with a metal detector can detect any land mine on its way, and wireless camera which will transmit the live pictures and videos remotely. This robot is also having a metal detector sensor, which will sense the presence of any mine in the survey area. It also having a robotic arm, which will be used to pick and place the bombs and mines. It will provide the facility to remove the obstacles in the way. It is equipped with some other sensors like fire fighting, which will detect the fire on the way and it has a pump motor which starts sprinkling water to extinguish fire. It also having a magnetic field detector which will detect any presence of the magnetic field on the way and alarm will start ringing. A moisture sensor is also placed on it, which will detect the presence of any moisture or we can say water in the survey area. This is the powerful technique which is used to at the terrestrial site to check if any water contents are present. It is also having a light sensor, which will sense the intensity of the light. When this intensity will fall below a certain value, it will automatically make the IR lights on to make the camera night vision. It is also having some weapons which will help it to fight in the survey area, like a cutter and the laser light. One more powerful tool is GSM module [2]. If by mistakenly the robot will move out of range of RF signal, then we will make the GSM module to work and make a call to the robot to get back in the range of RF. This unit is helpful and useful for surveillance of an area in

defence grounds for enemy, spying purpose where the human reach is not recommended or avoided. The unit is small handy portable and can reach places easily.

II.PROPOSED METHEDOLOGY

The DSR designed in this paper can be used in the environment which is hazardous to human. The various modes of operation for the robot are

- A. RF mode
- B. DTMF mode
- C. Automatic mode

In the RF frequency operation it will be controlled through the designed remote using RF module of 433 MHz Its range will be approximately 200 meters. In the GSM module it will be operated by a GSM mobile phone, when it will get out of the RF frequency range to get it back in the range of RF. Third mode is the autonomous mode. When we don't want to operate the robot manually, then we will set it into the autonomous mode. But it will still operate in the range of the RF frequency module. All the sensors will work automatically according to the conditions and will take the required action as well. The DSR consists of power supply, robotic arm; radio frequency module (433 MHz), DTMF module, LDR sensor for night vision and Flash light, audio and videos camera, Metal and magnetic field detector and thermistor for fire detection, moisture detector unit, laser gun as a weapon, robotic arm, IR sensors for path finding and obstacle avoidance are used in it. The wireless camera is used to capture the live video present in the surveillance area and it will be transferred RF receiver at the operator end which is further interfaced to the computer system using interface card. AT89S52 is used as a controller to accept and sends the corresponding data to the other section. Two hardware sections are designed that are

- A. Receiver end (robot with all sensors and other hardware)
- B. RF transmitter (Remote)

The block diagram of the receiver end is shown in Fig 1 and of transmitter end in figure 2.
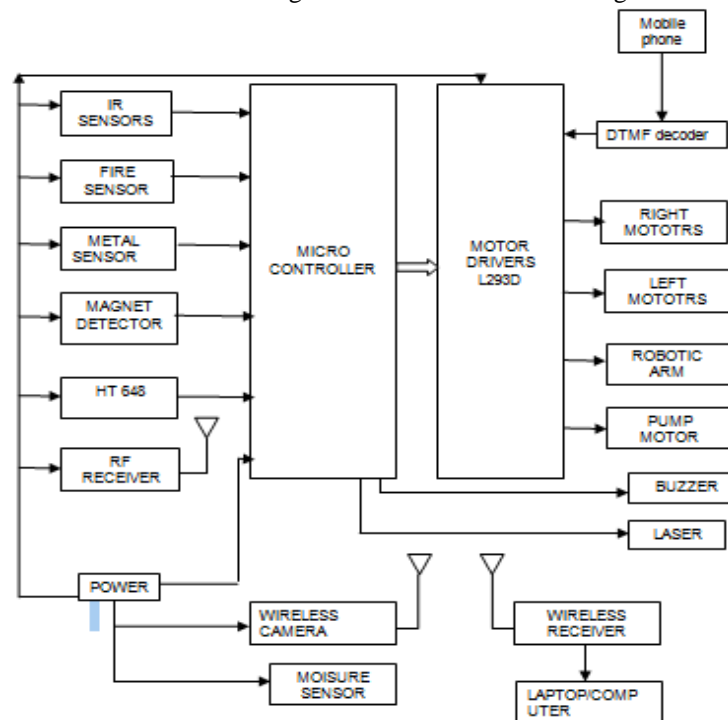
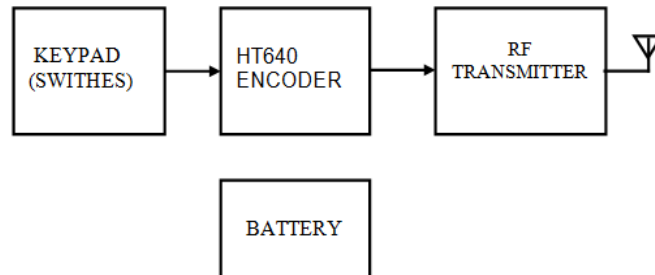Figure1. Block Diagram of DSR (receiver end)

Figure2. Block Diagram of remote (transmitter end)

III. HARDWARE DESCRIPTION

RF RECEIVER: 433 MHz RF receiver is used having 8 pin. This receives the RF signal transmitted and converts it in to digital data signal. And these have a range of up to 100 meters with no line of sight.

DECODER HT 648: These are 3^{18} series of decoders receives serial address and data from that series of encoders that are transmitted by a carrier using an RF. It then compares the serial input data twice continuously with its local address. If no errors or unmatched codes are encountered, the input data codes are decoded and then transferred to the output pins.

ROBITIC ARM: A robotic arm of 3dof (degree of freedom) is used, which is basically used to remove the obstacles in the way and also to place the bombs etc.

ATMEL (AT89S52): The AT89S52 belongs to the 8051 family of microcontrollers which have low power idle and power down mode, and are high performance computing devices. It works at crystal frequency ranging from 0Hz to 33MHz and executes most of complex instructions in a single clock cycle. It has 8KB of ISP flash memory, 256 bytes RAM, 32 I/O programmable lines, full duplex UART serial channel, a watchdog timer, power off flag and two 16 bit timer/counters [2]. It is used to interface various sensors and modules like GSM, RF modules and other sensors [3].

DTMF TECHNOLOGY: DTMF stands for Dual Tone and Multi Frequency which is basically used in the GSM systems. When we make a call from one GSM system to another then two frequencies associated with each key of the mobile phone is being transmitted. These two frequencies can be converted into 4 bit binary code corresponding to the decimal equivalent of the key pressed using an IC MT-8870. The following figure explains the two frequencies (lower and upper) associated with each key of the mobile phone.

FIRE DETECTION: Fire detector sensor makes the use of a thermistor (heat sensitive resistors), so output is produced when the fire is detected in the region.

Table 1: Frequency chart of DTMF

	1209	1226	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	3	9	C
941	*	0	#	D

DC MOTOR: DC motor is used for movement and locomotion purpose of the rover. It has high revolution per minute and low torque. In general robotics requires low revolution per minute and high torque. Hence gearbox is used to achieve this configuration, which reduces the rpm and increases the torque. The operation is based on the principle of electromagnetism which states the magnetic field is generated by a current carrying conductor and when it is placed in an external field, it experiences a force proportional to the current in the conductor. The speed of the motor can be controlled by changing the voltage applied to the armature or by changing the field current.

PUMP MOTOR: It extinguish the fire there is a motor called as small pump motor is attached to the robot, which will extinguish fire by sprinkling the water on it.

MOTOR DRIVER: L293D is a monolithic integrated high voltage; high current four channel driver designed to accept TTL logic levels and drive switching power transistors.L293D is assembled in a 16 lead plastic package which has 4 centre pins connected together and used for heat sinking. It is designed to control 2 DC motors. It requires separate power supply because it operates at high current and low voltage hence the operation of the whole circuit is protected from it by using separate battery supply. There are 2 Input and 2 Output pins for each motor. This device is more suitable for switching application at frequencies up to 5 kHz. It has two H-bridge hence it drives two motor. Its operations are shown in the table below.

MOISTURE SENSOR: This sensor is used to sense the presence of water or moisture in any area. It can be used at the terrestrial sites to detect the presence of moisture or we can say water.

Table 2: Operation of motor driver

Operation	Driver 1	Driver 2
Stop	Low	Low
Clockwise	Low	High
Anti clockwise	High	Low
Stop	High	High

METAL DETECTOR: Metal detectors are useful for finding metal enclosure hidden within the object or metal objects buried underground. Metal detector is used here as a bomb detector. Inductively coupled coil is used to find out the metal present inside the ground. It absorbs the magnetic field comes out from the metal and gives the acknowledgement to the control unit. Metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If the current carrying metal is close to it, eddy currents will be induced in the metal and this produces a magnetic field. Magnetometer is used to measure the magnetic field, the change in magnetic field indicates the metal present inside the surface [4].

LIGHT DEPENDENT RESISTOR (LDR): Light dependent resistor is very useful especially in light/ dark sensor circuit as shown in figure 3. Normally the resistance of an LDR is very high (1000000 ohms) but when they are under light its resistance drops significantly. We are using 10 X LDR sensors in this project. It principle behind its working is, when it's dark, the LDR has very high resistance. Due to high resistance the voltage across the base of the transistor is not sufficient enough to turn on the transistor so current path from collector to emitter is blocked. When LDR is illuminated, the transistor is turned on allowing the current path from collector to emitter.
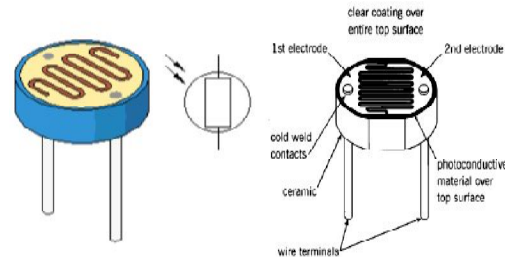
Figure3. Light dependent resistor

WIRELESS CAMERA: A camera is a device that records images, either as a still photograph or as moving images known as videos. This is used in the robot to take the video surveillance of the area. And it is transmitted using a carrier signal. On the receiving end it is converted to video signal. It has a range of 70-100fts with no line of sight [5].

IR SENSORS: The sensor used is the TSOP1738. It only senses the signal of frequency 38 kHz. This sensor is used to avoid the reception of signals from other sources. The 38 kHz signal is only used by TSOP1738, it can be horizontally mounted. It senses the reflected IR rays from 38 kHz IR source to detect any obstacle on its way.

MAGNETIC FIELD DETECTOR: four magnet detector sensors in the robot which detect the presence of any magnetic field in the region to provide security. They give the response by making the buzzer to beep.

IV.SOFTWARE DESCRIPTION

µVISION FOR AT89S52: Kiel software is used for the software implementation of the developed system. With help of it, we can generate embedded applications for the multitude of 8051 and 251 derivatives**. µvision4** Integrated Development Environment is an IDE that make facility, editor and powerful debugger. It is used for compile the programs [6]. In this project, coding is written for all modules, sensors, switching unit which are interfaced with AT89s52 microcontroller. As per the embedded in the controller, the interfaced modules and sensors generate appropriate output at the receiving terminal.

PROTEUS 7.0 FOR CIRCUIT SIMULATION: Proteus 7.0 is a virtual system modelling that combines circuit simulation, animation components and microcontroller model to co-simulate the complete microcontroller based designs. In this project, virtual simulation circuit is designed with help of proteus for testing [7].

V.RESULTS

In this project, we have developed a robotic system which is operated using the RF transmitter and receiver designed. A software code embedded into microcontroller controls the working of various sensors and weapons embedded on the robot. DTMF works by making a GSM phone call to the mobile phone attached on the robot, when it gets out of range of RF. Robotic arm is successfully embedded on the robot for pick and place operation in the surveillance area. Thermistor senses the fire and make robot to stop and pump motor to sprinkle water until the fire got extinguished. IR sensors attached find path by detecting obstacles on the way in the automatic mode of DSR. Metal and magnetic detection sensors detect bombs and mines. Laser gun attached works when any adverse condition happens or robot is being attacked by any personnel. Moisture sensor basically indicates the contents of water by injecting the needle in soil attached to robotic arm. The level is indicated using the LEDs interfaced with the sensor. Some feature of DSR is: Distance sensing and position logging & transmission, Radar implementation, Equipped with Missiles, Can be operated on 3G technology with the video calling.

Figure4. Defence Surveillance Robot

VI.CONCLUSION

A defence surveillance robot was designed in the project. Using the RF remote control and sensors to sense the path and obstacles, controller program was designed so as to enable the microcontroller to control robot, using RF remote and movement of the robot and move when there is no obstacle in the following path. The program could also read data from sensors and produce the controlling actions respectively. The motor drivers are used to drive the motor. Obstacle sensors are used to change the movement of robot when the robot faces an obstacle on the path. Other areas of applications includes

    A. Space Exploration
    B. Hazardous Area Maintenance like Nuclear Power Reactors Mining
    C. In hospitals to Maintain Sterile Environment
    D. Industrial Automated Equipment Carriers

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BIOGRAPHY

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