

SOUND FIRE EXTINGUISHER ROBOT CONTROLLED BY SPEECH

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ABSTRACT: *The main objective to design and build a sound fire extinguisher robot prototype system that could extinguish a fire using sound. The Sound Fire Extinguisher Robot is a device that uses acoustic waves to suppress a flame/fire. The robot is controlled through User Voice Command. The voice input allows a user to interact with the robots which controls the movements of the robot. The controlling device of the prototype is 8051 microcontrollers. Speech recognition module, Bluetooth module, amplifiers are interfaced to Microcontroller. This Robot can be used in Rescue operations during fire accidents where the possibility for servicemen to enter the fire-prone areas is very less. The Controller can be interfaced to the Bluetooth module through UART protocol. Based on commands received from Android the motion of robot can be controlled.*

Keywords: *Fire Extinguisher, sound, Bluetooth module, microcontroller chip, voice control,*

I. INTRODUCTION

Firefighting and rescue activity is considered the risky mission. They are an ideal target for robot technology to keep away firefighters from danger. Moreover, it makes possible to rescue much more victims. Some fire departments have already developed and deployed firefighting and rescue robots. However, the performance of the robots is not enough they are considered and examines following points of view: "size and weight", "cost and performance" & "Availability of resources to extinguish the fire" [1]. A robot is a mechanical and virtual intelligent agent that can perform tasks automatically or with guidance, typically by voice. Present extinguisher contains different chemicals, depending upon their application. Generally, they are pressurized with Nitrogen or Carbon dioxide (CO₂), when this pressure released on fire will extinguish the fire, as we know there are many such firefighting agents such as water, potassium bicarbonate, evaporating fluorocarbons etc. Also, all these resources are limited during the time of extinguishing fire. Despite such kind of behavior of fire, there is a chance of extinguishing it by sound. If we discuss the procedure of spreading fire, with enough amount of fuel and oxygen and heating element fire is caused, the very first heating element from any source ignites the fuel in presence of oxygen, hence as air molecules get started burning, these molecule now behaves as heating element for other molecules around it and the process of convection (the movement of air) is done naturally on ground. As a summary, we can say that fire is made to spread by heating elements. What if we remove this heating element or move it apart from fuel. This particular task is done by sound [6] and fire can be easily extinguished without any risk to human life and hazard to nature.

In this system, an android application is used to recognize human speech and is converted to text. This text is further processed and used to control the robot. Keeping in mind the requirements of the present day making accessible to the manipulation of everyday objects to individuals with motor impairments. Using this system perform several studies on control style variants for robots. Results show that it is indeed possible to learn to efficiently manipulate real-world objects with only voice (human speech) as a control mechanism. The results provide strong evidence that the further development of voice-controlled robotics will be successful. Also the system performance will be increases, reduction of size and weight is possible and satisfies condition of resources availability effectively.

II. BLOCK DIGRAM

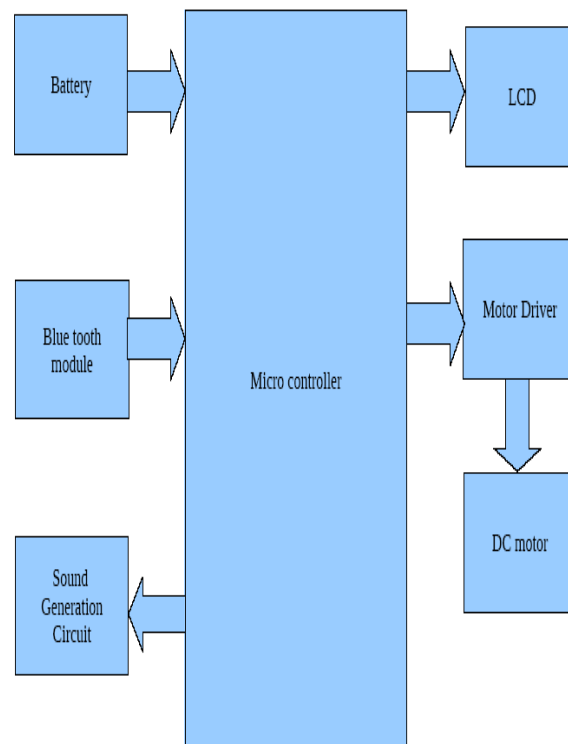


Fig 1: Block diagram of “Sound fire extinguisher robot controlled by speech”

This sound fire extinguisher robot operates on 12V battery, DC motors, Bluetooth module HC-05 and an AT89S52 microcontroller with Android Smartphone device. Figure 1 shows the Block diagram of “Sound fire extinguisher robot controlled by speech”. The controlling devices of the whole system are a microcontroller. The input delivery by the Bluetooth module from Android Smartphone is fed as input to the controller and controller acts accordingly on the DC motor for movement of the robot and sound generation for extinguishing the fire. The robot in the project can be moved in all the four directions. In achieving the task the controller is loaded with small device ‘C’ compiler (SDCC) using USBASP adaptor. LCD is used for displaying current operation.

i. System Design Of Sound Generation

Sound generation system is design by using following parameter and component,

- Audio Amplifier - Amplifies the audio signal from 5V to 19 V

- Frequency Generator - Selects frequency into the amplifier 60Hz - 95Hz
- Power Supply Unit - Powers audio amplifier (high current)
- Acoustic Output - Emits acoustic signal
- Collimator/Vortex - Focuses acoustic output to form vortex

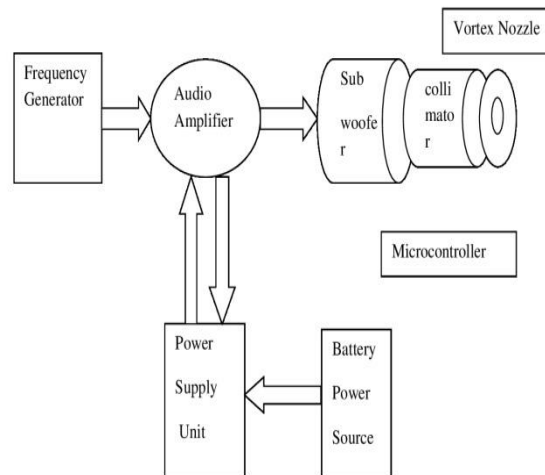


Fig 2: System design for sound generation

i. AT89S52

The AT89S52 is a low power, high performances, and CMOS 8-bit microcontroller with 8Kbytes of in-system programmable flash memory. The device is manufactured using Atmel's high-density non-volatile memory technology and incompatible with the industry standard 80C51 instruction set and pinout. The AT89S52 is a powerful microcontroller which provides a highly flexible and cost-effective which provides a highly flexible and cost-effective solution to much-embedded control application. The AT89S52 provides the following standard features: 8Kbytes of flash, 256 bytes of RAM, 32 I/O lines, watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. The AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The power down mode saves the RAM contents but freezes the oscillator, disabling all other chip function until the next interrupt or hardware reset.

ii. HC-05 Bluetooth module

HC-05 is a serial Bluetooth protocol for Bluetooth serial interface module and Bluetooth adapter. Bluetooth serial module is used for converting serial port to Bluetooth.

Specifications:

- Bluetooth Protocol V2.0
- Range – 5 - 9 meters
- Frequency – 2.4GHz ISM
- Modulation – AFH (Adaptive frequency Hopping)
- Transmit power – 4dBm
- Sensitivity – 8dBm
- Power supply – 1.8 to 3.3V
- Rate – 3Mbps (Max.)

iii. *L293D(Motor Driver IC)*

The L293 and L293D devices are quadruple high current half H-Drivers. The L293 is designed to provide bidirectional drive currents of up to 1A at a voltage from 4.5V to 36V. The L293D is designed to provide bidirectional drive currents of up to 600mA at voltages from 4.5V to 36V. both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high current/ high voltage loads in positive supply applications.

iv. *DC Motors*

Almost every mechanical movement that we see around us is accomplished by an electrical motor. Electric machines are means of converting electrical energy into mechanical energy. An electric motor is used to power hundreds of devices we use in everyday life. An example of small driving motor applications includes driving motors used in automobiles, robot, and food blenders. Micro-machines are electric machines with parts with the size of red blood cells and find many applications in medicine.

v. *UART*

Universal Asynchronous Receiver Transmitter is usually an individual integrated circuit used for serial communications over a computer or peripheral device serial port. UART is now commonly included in microcontrollers. A dual UART combines two UARTS into a single chip. Many modern ICs come with a UART that can also communicate synchronously. These devices are called UART.

III. WORKING

The sound fire extinguisher robot operates as per the command received by android application through Bluetooth module HC05. For this 89S52 microcontroller is integrated with the system which makes it possible to operate the vehicle via the android application. The controlling device may be any android-based Smartphone/tablet etc having an Android OS. The android controlling system provides a good interactive GUI that makes it easy for the user to control the vehicle. The receiver end reads these commands and interprets them as controlling the robotic vehicle. The Android device sends commands to the microcontroller through Bluetooth module to move the vehicle in forward, backward, right and left directions also used to a generation of the sound which is used to extinguish the fire. After receiving the commands, the microcontroller then operates the motors to move the robot in four directions and reach the fire location and blow the sound through the speaker to extinguish a fire. The output of the sound is focused on fire by using conical shape tube, shown in figure 3. Due to this conical shape fire can extinguish early than other fire extinguishing agent without damaging the environment. The communication between android device and receiver is sent as serial communication data. The microcontroller program is designed to move the motor through a motor driver IC as per the commands sent by the android device. The status of the operation is shown on the LCD for information robot is work correctly.

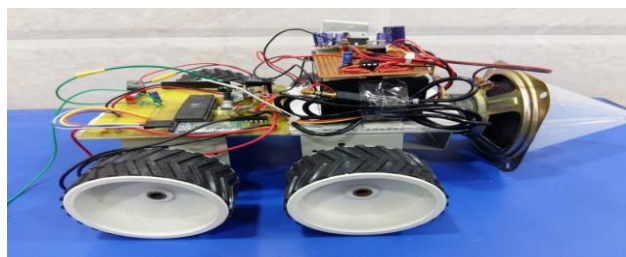


Fig Sound Fire Extinguisher Robot Controlled by Speech through Android Application

IV. ADVANTAGES

Sound fire extinguisher robot performance satisfies the following points of view: "size and weight", "cost and performance" & "Availability of resources to extinguish the fire" [1]. The sound fire extinguisher has less weight and compact size so that it is easy to operate. Due to this it gives high performance and reduces cost. Use of sound eliminates the disadvantages of water and chemical fire extinguishers.

V. FUTURE SCOPE

A booster can be attached to the vehicle to make it a powerful extinguisher. For security purposes, authentication for accessing the robot can also be done. A piston spray can be used which uses the concept of formation of mist as a heat absorbing ability to reduce heat. The vehicle can be mounted with a thermal camera so that auto detecting of heat areas is made possible and live images of the incident can be seen through a wireless camera. GPS enabling can be done so that the vehicle can be controlled from a remote place and the communication range also can be increased by using XbeePRO.

VI. CONCLUSION

The idea of Sound Fire Extinguisher Robot controlled by speech potentially serves as an alternative to traditional fire extinguishers. It can be programmed to alternate the frequency based on a width of the flame. So it can be possibly used for a larger area. Without risking human life or limb, robots can replace humans in some hazardous duty service. Robots can work in all types of polluted environments, chemical as well as nuclear. They can work in environments so hazardous that an unprotected human would quickly die.

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