

Design & Implementation of Voice Command Based Bipedal Surveillance Robot

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Abstract— Surveillance of international border areas, industries, banks, shopping malls, and any other suspected areas is a difficult task to be done. It is not possible to scrutinize everything at each and every moment. In this case, a requisite solution can be a robot which automatically detects any suspicious activity or condition and reports to the control unit. This paper is on a bipedal surveillance robot which can budge in an area, send images and videos even in caliginous condition by using night vision mode of the Wi-Fi camera as well as the installed sensor on this robot provides gaseous parameters of the area such as the amount of Methane, LPG, Carbon mono-Oxide. The robot has a wireless Bluetooth module for communication and collection of data. The whole process can be run on a voice command system. After the data collected from the robot, data are appraised and analyzed to get an understandable idea of the surveilled area.

Keywords— Surveillance Robot; Bipedal Robot; Gas Sensor; Night-Vision camera; Voice Command; Wireless Communication.

I. INTRODUCTION

From the dawn of civilization, there were always problematic activities that imbalance the whole socio-economic stability of a country. Terrorist attacks or Trespassing of the border is one kind of these problems. In many times, it is seen that the surveillance of these situations get very condemnatory as law-enforcers cannot get to the place at the right time. Even if they can reach, they may face a deadly counter-attack there. Some such kind of incidents occurred in Dhaka when some militants took over a café named as Holey Artisan café [1-3] or Rohingya trespassing from Myanmar into Bangladeshi border [4-6]. The multifaceted employability of robot has brought the chance to send them in a place where human life can be at stake. However, with the modernization of robotic technology, the appeal towards the human look-alike robot is increased. Bipedal Robot with the advantages like more energy efficiency [7-8], better handling capacity of the rough terrains, more maneuverability and better Human-Robot Interaction (HRI) [9], has emerged as one of the interesting research sectors in the robotics field. A chemical attack is another recent problems arising across the world [10-11]. Sometimes it is been treated more dangerous than nuclear weapons. So, it is now a crying need to sense the presence of the toxic gases in a place. Any chemical attack can be breached by avoiding the place by sensing the levels of toxic gases like Carbon-Di-Oxide (CO₂), Carbon mono-Oxide (CO) and Methane (CH₄) of the specific place with the use of the gas sensors. If the still pictures or the motion pictures can be found through any system then it would be more planned

to counter these havocs. But the surveillance could have been done with perfection if there were any availability of surveillance robot system. With all these, there is another feature that can be developed and that is the Voice Control [12] which makes the whole system more efficient and encrypted as it gives the system a massive advantage which is to control it from a significant and safe distance. In our project, we will try to seek out these problems with the help of a Bipedal Robot which can go to a place without any human intercession where the gas sensor and night vision Wi-Fi camera are installed on it to get the data about the gaseous condition, images and videos even if in the obsessed situation. Bluetooth module is used to send the Voice Command and to transmit the data. The project also illustrates the ways to develop a Bipedal Robot and also dispenses the data transmitted from the robot during its exploration.

II. LITERATURE REVIEW

Above last decades, many researchers have designed different purpose soldier or surveillance robot. Soldier or surveillance robot is a robot which does the surveillance of International border areas, war field and terrorist activities [13]. Arduino controlled war field spy robot using night vision wireless camera and Android application is very muchly used nowadays [14]. For the implementation of this robot night, vision camera is used for monitoring and for operating Bluetooth module is used. Implementation of Spy Robot for a surveillance system using internet protocol of raspberry pi where sensors are used to detect the living object and night vision camera is used to capture the pictures of the object [15]. Wireless Controlled Military combat Robot system is a work where the micro wireless camera is fitted and where the video and voice transmitted to the control room by using the Bluetooth Module [16]. The bipedal structure is another recent conception in this sector to give pace to this specific robotic research [17]. It is done to avoid the obstacles on the way to the target. Rough terrain can be topped as like as human leg behavior by this structure. Along with this, Voice command is now playing a vital role in the establishment of a surveillance robot with more perfection [18]. Bipedal Structure has the advantages over the wheel based robot as it has the lighter weight, has higher efficiency as it has the less number of the actuator and better Human-Robot Interaction (HRI). Along with this Voice, command helps the user to control the surveillance robot from a distance which can be very significant. Android applications are made to provide the voice command by using Bluetooth Module

[19]. In addition, Arduino Movi-Shield, RF Transmitter Receiver Pair 433 MHz-RXB6, ZigBee communication modules are also used to transmit the voice command to the robot. The proposed robot can capture still images and videos by using night vision camera which also makes it perfect to send images and videos even in the night time. It can walk in unprepared terrain which is inaccessible for robots with wheels or caterpillars. It has the Gas sensor which is capable of providing data of the gaseous condition of the area under surveillance. The implemented robot is using Bluetooth module with Android platform for controlling purpose as well as to transmit the voice command.

III. PROPOSED METHODOLOGY

The upliftment of the research work is divided into 3 stages. They stand as mechanical, electronic and software portions after considering the plan for making a research work on the topic named Voice Command Based Bipedal Surveillance Robot. The upliftment procedure is represented in Figure 1. The Mechanical stage is divided into the parts as pursues:

- Design of Model
- Build the prototype
- Upliftment of Model Hardware

The Electronic stage is divided as pursues:

- Design of Circuit Diagram
- Circuit Simulation
- Upliftment of Circuit

In the software stage, an algorithm is designed as per as the plan and the programming is sorted according to the algorithm.

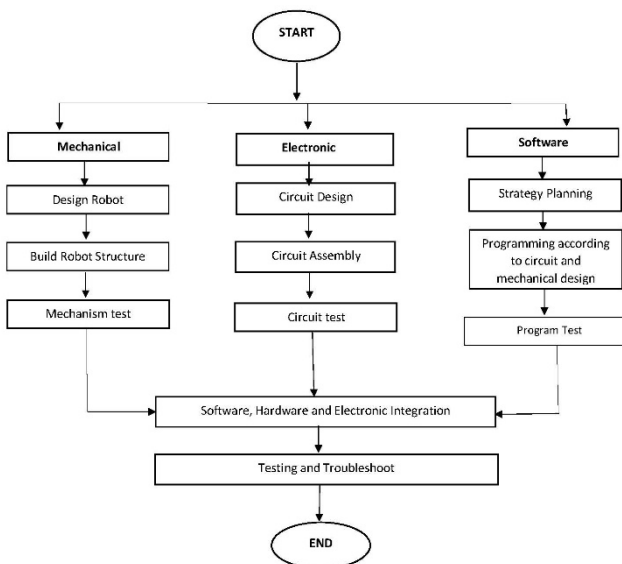


Fig. 1. Methodology of a Bipedal Surveillance Robot

IV. PROPOSED SYSTEM DESIGN

By taking into account its better performance over long distance data transmission from the working station the proposed robot is designed so that the user can take the idea

under the surveilled area and can control the robot. Block diagram of the proposed system shown in Figure 2 & Figure 3.

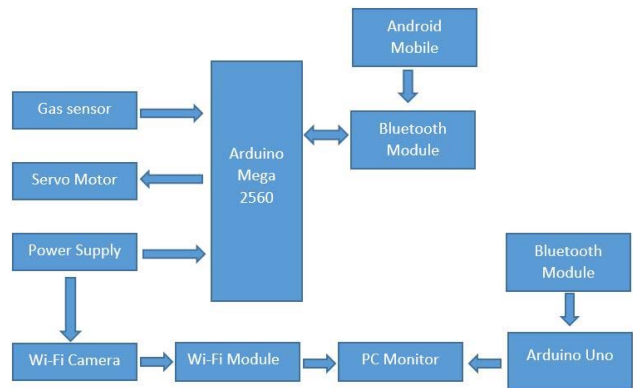


Fig. 2. Block Diagram of the Proposed System

The robot is controlled by voice command using a Bluetooth module. Voice command is transmitted by an android application. The robot collects gaseous data by a gas sensor and sends to the user with the help of the Bluetooth module as well as the robot sends the video using a smart wifi camera with night vision mode which enables it to operate even in the darkness.

In the process of building a surveillance robot, both mechanical structure and electronic components are needed

A. Mechanical Structure

In the proposed model, Acrylic plastic sheets which have 2mm thickness are used to build the structure of the model. On account of lightweight and better flexibility, this sheet is considered. In the purpose of movement, 6 metal gear servo motors are used in hip, knees, and ankles of both legs. Figure 3. shows the 3D model of the proposed system.

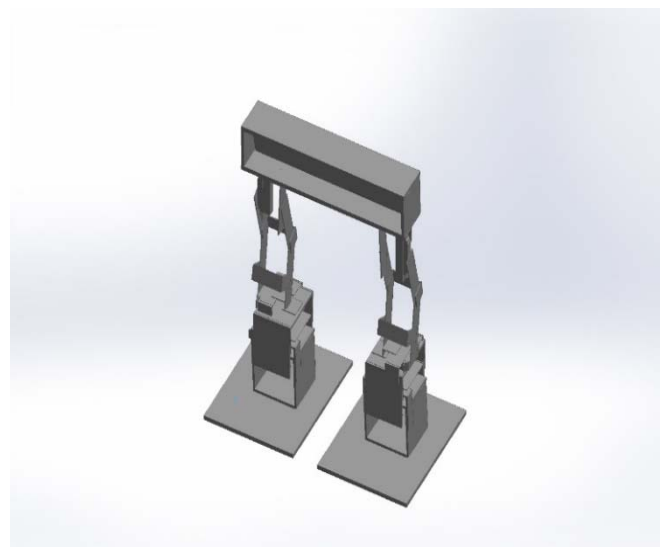


Fig. 3. 3D Model of the proposed system

B. Electronic Components

On the purpose of transmission, sensing and controlling motive, there are some components which are used and their names are given below:

- Arduino Mega 2560 and Arduino UNO
- Gas Sensor(MQ-5)
- Servo motor
- Bluetooth Module(HC-05)
- Wi-Fi Smart Camera

C. Design of Circuit Diagram

The circuit diagram of the proposed system exposes in figure 4. PROTEUS[®] software is used to design and partial simulation of the circuit. Since there was no way to simulate gas sensor with the presence of real gas, the simulation of gas sensor was do/-*

ne by imitative binary input to the Arduino. At the time of implementation, the circuit diagram had been modified which was designed in the simulation software. After the completion of the design, simulation and implementation of the circuit in the robot, the expected result has come out.

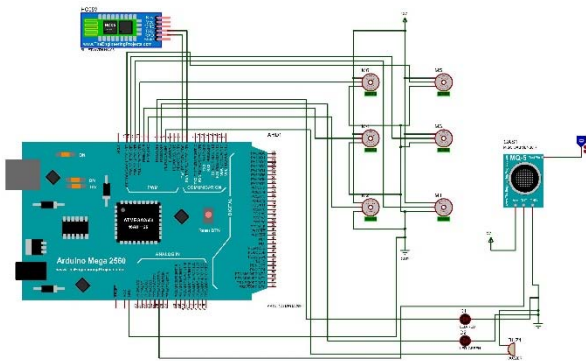


Fig. 4. Circuit Diagram of the Proposed System

D. Gas Detection

Toxic gases in the air are addressed in the microcontroller and the amplitudes of their concentration were measured by using gas sensors. To measure the specific gas concentration, the sensor indicates the result as the reference point or scale in a Concentration versus Time curve. When any toxic gas is found in the air, an alarm is rung by using a buzzer. There are two types of gas sensor have found. One is an electrochemical gas sensor which is used for detecting LPG, CO₂, CO, CH₄, etc. and another one is metal oxide semiconductor (MOS) which is used for inflammable gases.

V. HARDWARE IMPLEMENTATION

Figure 5 shows the final implementation of the robot after the development and combination of mechanical construction and circuit diagram. Hither Arduino Mega 2560 board and Bluetooth module are used for controlling the robot and transmitting and receiving data respectively. The gas sensor is used for detecting the toxic gases as like as LPG, CO, CH₄. In this project, the most complicated part is the movement of

the robot accurately. Stabilization is done by using proper materials and following correct procedures of building it.

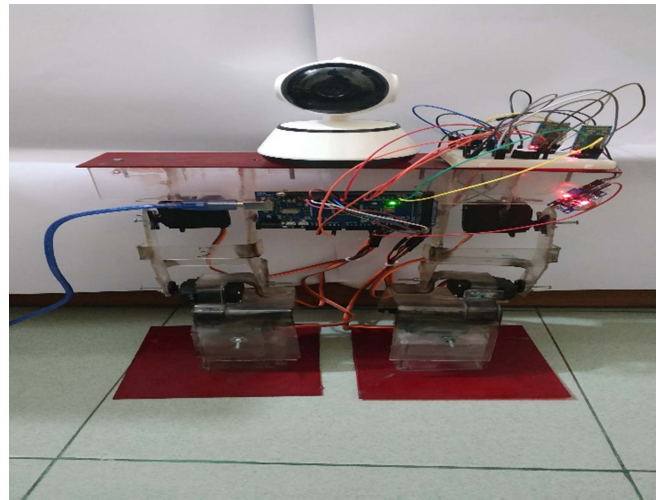


Fig. 5. Implemented prototype of the Robot

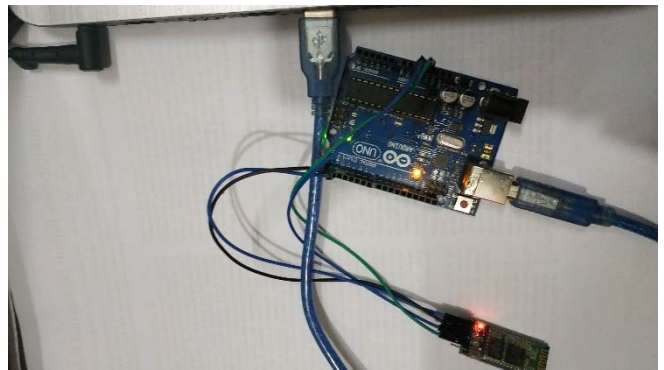


Fig. 6. Implemented Gas sensor Data Collecting station

Figure 6 shows the gas sensor's data collecting station. Here Arduino UNO and Bluetooth module are used to receive the data of the gas sensor.

VI. SOFTWARE DESCRIPTION

Various types of software have been used for mechanical design, circuit design, real-time data analysis which are:

- Arduino: Arduino is an open source electronics platform by which many types of sensors, motors, lights, etc. can be controlled. Two types of Arduino Board have been used for the robot.
- Proteus: For Circuit Design and Simulation, it is a famous software. Since the software is easy to design and simulation, it's used for the simulation purpose.
- Blender: For 3D character design, Blender is a compatible software. Using this software, the 3D design of the robot is drawn.
- MATLAB: It is a multi-paradigm numerical computing environment and fourth-generation programming language. It is used in this project for the purpose of plotting of the collected data from the receiving module of the gas sensor.

- **Android Application:** An Android application is a smartphone software which runs in the Android OS platform. In this project, an android application is used to transmit the voice command with the help of Bluetooth connectivity. Figure 7 shows the android application which is used to transmit the voice command using google voice command.

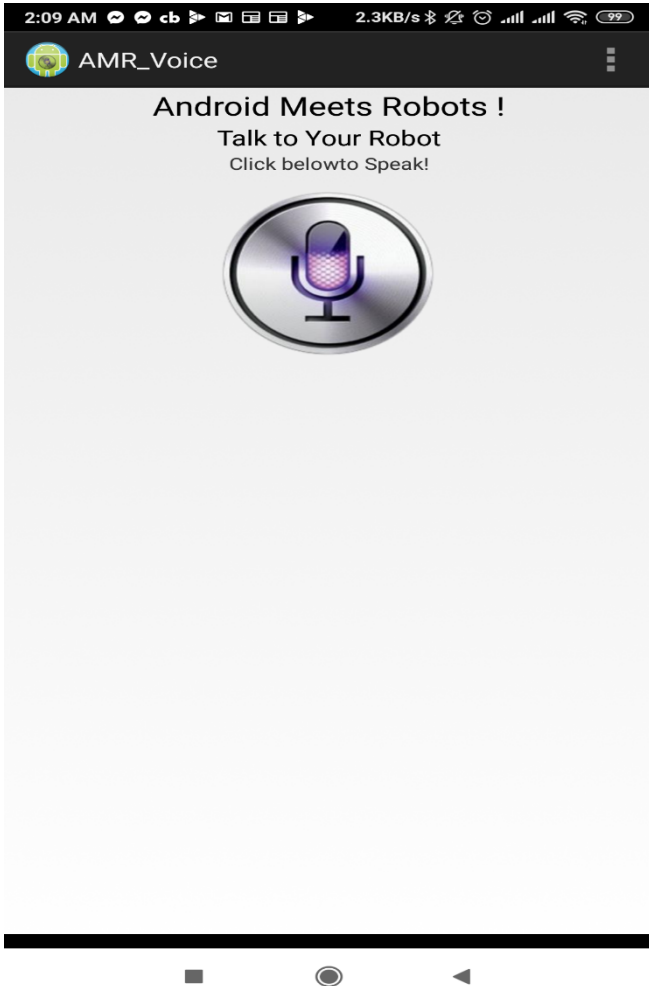


Fig. 7. Android application

VII. EXPERIMENTAL RESULT

The main goal of this project was to develop a robot which can be sent to a place where surveillance is needed and to know about the condition of this place by video streaming continuously and sensing the condition of toxic gases in the air of this place by it. It was a must to give it a capability to send data to the user by which the state of the place can be both analyzed and realized. It was not possible to conduct this environment in any real field area. So, we created an artificial environment to test this robot. The video streaming is shown in figure 8. It can send data in both bright and dark condition using night vision mode which makes the robot capable of operating in 24 hours of a day regardless of the light condition.

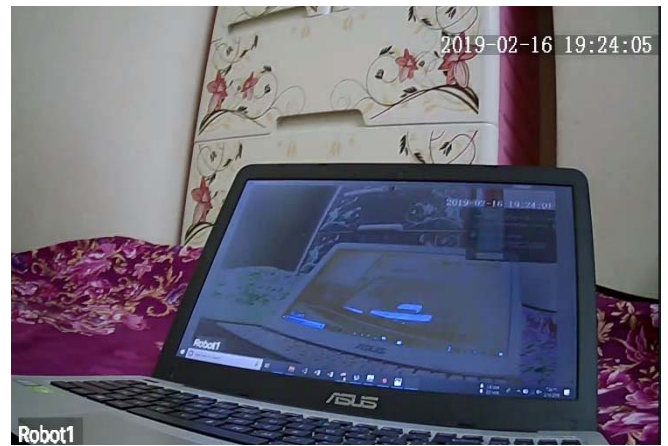


Fig. 8. Video streaming of the surveillance place

The Collected data from the gas sensor illustrated here:

a) *Methane Gas (CH₄):* The Methane gas variation is respected to time which is shown in figure 9. The amount of methane gas varied from 0-500 ppm. The result is shown in figure 8.

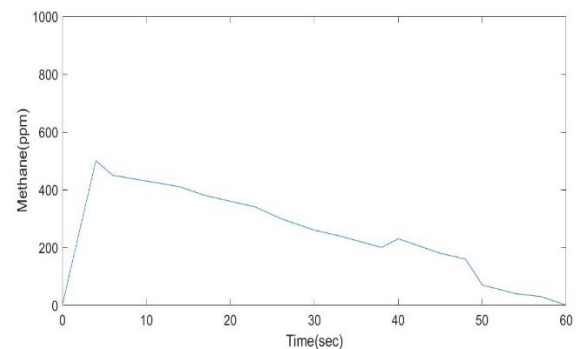


Fig. 9. Change the amount of Methane Gas over time

a) *LPG:* Figure 10, Shows the amount of LPG gas which was varied from 0-800 ppm. Release of the LPG gas and the decreasing rate of it can be analyzed from the plot.

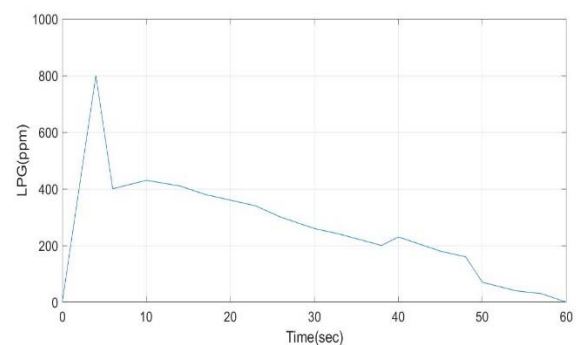


Fig. 10. Change of the amount of LPG Gas

b) *Carbon mono-Oxide (CO):* In figure 11, it shows the amount of CO gas over time. It varies from 0-430 ppm. By the figure, get a clear idea about the rate concentration of CO in the air.

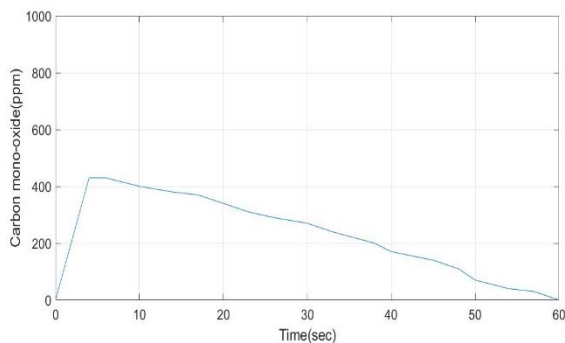


Fig. 11. Variation of the amount of CO over time

VIII. CONCLUSION

The experiment was taken in a room so the actual data is not collected. Without this, the project covers all types of design and development. It can detect LPG, CH₄, CO. through the sensor. To analyze this data get a clear idea about the environment. By the video streaming know the condition of the place. It might be a suitable one because of walking in unprepared terrain where wheel robot is faced with difficulties.

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