NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 11, ISSUE 10, October – 2025

ADVANCED MILITARY SPY AND BOMB DISPOSAL ROBOT

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ABSTRACT
This system makes use of a robot which helps not only to enter an area involving high risk but also to pick whatever object it wants to. It also includes a wireless camera which is used for obstacle visualization video on mobile. This system makes use of a robot mounted with Bluetooth, a robotic arm with a gripper & cutter, Servomotors and a Controller. The whole system is controlled via Bluetooth technology using mobile. The system sends commands through mobile to the controlling device mounted on the robot. At first, the system is set to control the movement of the robot. The user needs to control the robot through mobile app in whichever direction the user wants to move the robot. When the user visualizes any obstacle similar to a bomb scene command by the sensor, commands are sent to the robot to take further actions. At present, bomb explosive materials like Ammonium Nitrate (NH4NO3) and firecracker explosives are tested using a smart Sensor. This helps whether the obstacle detected is an explosive material. If it is a bomb or any kind of explosive material, the robot is given commands to lift the obstacle (Bomb) or explosive material and dispose of it at a remote location.

Keywords: Sensor, Robot, Bomb, Arduino, Bluetooth.

Introduction:

An explosive substance or a device that rapidly releases a large amount of energy when it is exposed to heat, collision, friction or detonation [1]. At present, to detect explosive materials used in bombs, costly testing equipment like FTIR Spectroscopy or Raman Spectroscopy, Chemical Sensors and Nano-sensors. Almost every day so many trained people get either injured or lose their lives while dealing with or trying to defuse bombs or explosive materials. All this can be perceived by the countless number of news articles and documentaries that appear daily on news channels and print media around the world. The main idea is to develop a smart electronic sensor which will be more cost-

effective than FTIR Spectroscopy and Raman Spectroscopy used to detect explosive materials used in bombs. Our system is designed by keeping in mind, the view of the current civil wars, military instability and terrorist scenarios across the globe. The robot here is to serve the bomb disposal squad by providing safety and security from the danger that they are facing in their daily lives. It has a wireless camera for video feedback so the operator can operate more efficiently without human interaction nearer to such obstacles.

The operation of the robot is controlled by using a wireless camera module so it can provide more range of operation. Hence, the robot can reach any remote place for disposal. The mobile robot reduces or eliminates a bomb technician's time-on-target. A robot takes the risk out of potentially deadly scenarios and lets the bomb technician focus on what to do to an explosive device rather than on the immediate danger to life and limb. In addition, events recorded by a robot's camera can provide evidence for further analysis.

1. Bomb Detection Techniques:

There are few techniques which are used for detection of explosive materials in the bombs viz,

a) IR Spectroscopy: IR Spectroscopy is used to detect explosive substances or materials in public locations such as airports, train or bus stations, by enforcement agencies and police. IR Spectroscopy shows vibrations of different Chemical properties.

b) FTIR Spectroscopy: In FTIR Spectroscopy, sample preparation either solid, liquid or gas is required. The analysis is done by passing an IR breakthrough the sample using an optical mirror system. Thus, it shows characteristic absorption of that particular substance or material.

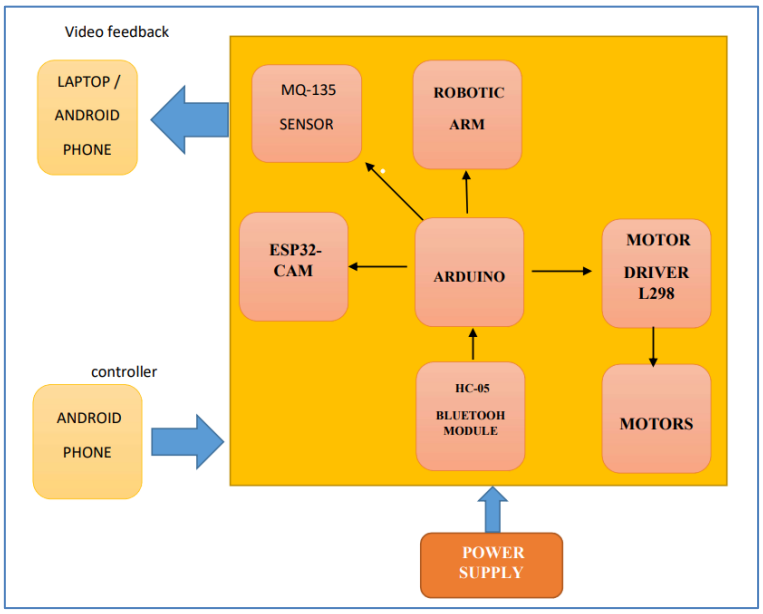
c) Raman Spectroscopy: Raman Spectroscopy uses inelastic light scattering. It transfers the data from the infrared to the visible spectrum. This technique has only trace-level identification.

Thus, the drawback of the above Spectroscopy is that one is required to prepare the sample and only trace-level identification can be done. Also, tools, Materials and setup requirements are large-scale and costly.

2. Features of Advance Military Spy & Bomb Disposal Robot:

- In these techniques, the Robot is used for the identification and detection of bombs or explosive Materials and makes decisions on how to dispose of the bomb by the commands by camera or make a specified action by wireless technology It makes the controlling action very easy by wireless technology without physical interaction by the human.
- Users to manipulate the suspicious packet using the robotic arm.
- The Robotic arm performs various functions like, lifting the disposal material or bomb or the user wants tomove obstacles wherever to reach for disposal.
- The arm also has inbuilt cutting tools.
- The requirement for power consumption is very low.
- The controlling Robot is processed by wireless Technology to instruct the appropriate module
- It is lightweight and works in places were humans can't reach physically. The operator can control the Robot from the safe zone area.

BLOCK DIAGRAM:



HARDWARE DESCRIPTION:

COMPONENTS USED:

2.1.1 Arduino UNO:

Arduino is an open-source microcontroller which can be easily programmed, erased and reprogrammed at any instant of time. It is also capable of receiving and sending information over the internet with the help of various Arduino shields, which are discussed in this paper[4]. Arduino uses a hardware known as the Arduino development board and software for developing the code known as the Arduino IDE (Integrated Development Environment).

2.1.2 Bluetooth Module HC-05:

Bluetooth Communication is a 2.4GHzfrequency-based RF communication with a range of approximately 10 meters. It is one of the most popular and most frequently used low range communications for data transfer, audio systems, hands free, computer peripherals etc.

4.1.3 MQ-135 Sensor:

The MQ-135 sensor can be implemented to detect smoke, NH3 and other hazardous gases. It consists of a sensing element with electrodes housed inside a steel mesh. The sensing material is heated to make it more reactive and sensitive. When the gas reacts with the electrodes, its resistance changes and vice-versa. The range of sensing Ammonia, Benzene, and Alcohol is 10ppm – 300 ppm, 10 ppm – 1000 ppm and 10 ppm –300 ppm for air concentration levels. Features of MQ-135 has a wide detecting range and Fast response with high sensitivity [8].

4.1.4 ESP32-CAM:

ESP32-CAM is a low -cost ESP32 based development board with an onboard camera, small in size. It used in intelligent IoTapplications such as wireless video monitoring etc [3]. It has a main frequency adjustment range of 80MHz to 240MHz.

4.1.5Robotic Arm with Servo Motor:

At work, repetitive, dirty and dangerous tasks are as easy as one-two-three for a robotic arm with servo motors. The type of the engine provides accuracy, smoothness, and flexibility of motion comparable to a human limb, while excelling at repeatability [5].

4.1.6 DC-BO Motor:

A DC-BO motor is a type of DC motor that is designed To provide high torque output and is commonly used in robotics and other electronic projects.

- Working voltage of motor:3-6V.
- High strength, good toughness.

5. Testing and Analysis:

5.1 Analysis of 20 wt. % Ammonium nitrate solution [11]

A Raman-RXN1 spectrometer and a Raman- RXN-10 probewas used for the measurements. Following figure shows the analysis using Raman spectrum of a 20 wt. % ammonium nitrate with 80 wt.% deionized water solution. The characteristic
peak of ammonium nitrate, i.e., the NO3 − vibration band, is found at 1047 cm−1 as shown in figure 2. [11]

Table 1: Concentrations of the fluid system components in weight percent [11]

Continuous Phase		Dispersed Phase
Ammonium Nitrate/wt %	Deionized Water/wt %	Glass Beads/wt %
20.00	80.00	0.00
19.99	79.97	0.03
19.99	79.95	0.06
19.98	79.93	0.09
19.98	79.91	0.11
19.97	79.88	0.15
19.97	79.87	0.17
19.96	79.85	0.19
19.96	79.84	0.20
19.96	79.71	0.33
19.88	79.39	0.73
19.72	78.72	1.56
19.40	77.46	3.14

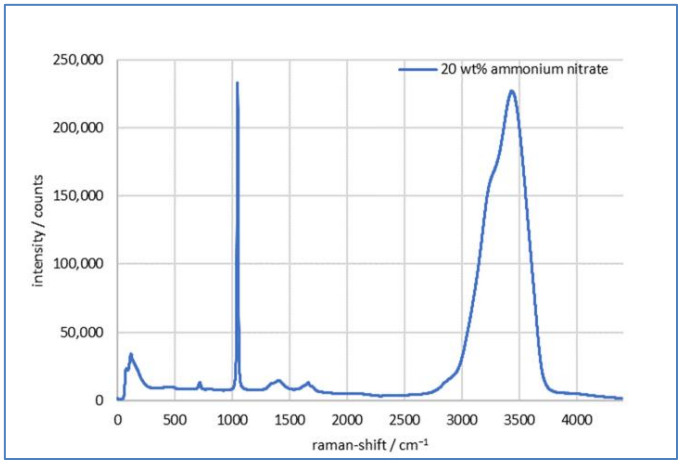


Figure 1: Analysis of 20 wt. % Ammonium nitrate. [11]

According to Table 1 and Figure 1analysis, the ratio between ammonium nitrate and deionized water, or rather the composition of the continuous phase was constant for all samples while in dispersed phase the refractive index of 1.359 was observed.

5.2 Analysis of Ammonium Nitrate powder using FTIR Spectroscopy.

FTIR spectroscopy is based on the idea that the interference of radiation between the two beamyields an interferogram. The latter is a signal produced as a function of the path length change between the two beams reflected from two mirrors (resides in the interferometer block).In this analysis, FTIR Spectrometer Spectrum Two of Perkin Elmer was used with Software version 10.5.2. This spectrometer consists of a UATR stainless steel top plated with diamond insert. The continuous laser-seamed weld provides additional solvent resistance. The diamond insert has a maximum temperature of 650°C.

5.2.1 Operating Procedure of Spectrum Two:

Initially, the UATR top plate was cleaned with a solution and sample of Ammonium Nitrate in powder form was placed at the centre above the diamond crystal. Then, a pressure tap was arranged exactly on the top of the sample and diamond crystal. Later, readings were observed on a PC having software Spectrum Two for analysing. Observation table and graphical representation of Transmittance (%T) and Wave numbers (cm-1) was observed as shown in figure 3 and figure 4.

Table 2: Observation Table

cm-1(wavenumber)	%T(transmitance)	cm-1(wavenumber)	%T(transmitance)
4000	98.3	3979	90.72
3999	98.29	3978	89.94
3998	98.31	3977	89.75
3997	98.32	3976	88.97
3996	98.01	3975	88.56
3995	97.89	3974	87.92
3994	97.88	3973	87.02
3993	97.87	3972	85.92
3992	97.01	3971	85.02
3991	96.92	3970	84.98
3990	96.82	3969	84.75
3989	96.71	3968	84.02
3988	96.01	3967	83.75
3987	95.83	3966	83.56
3986	95.32	3965	82.92
3985	95.3	3964	82.04
3984	94.92	3963	82.95
3983	94.04	3962	83.92
3982	93.06	3961	83.56
3981	92.06	3960	84.23
3980	91.43	3959	88.23
		3958	90.56

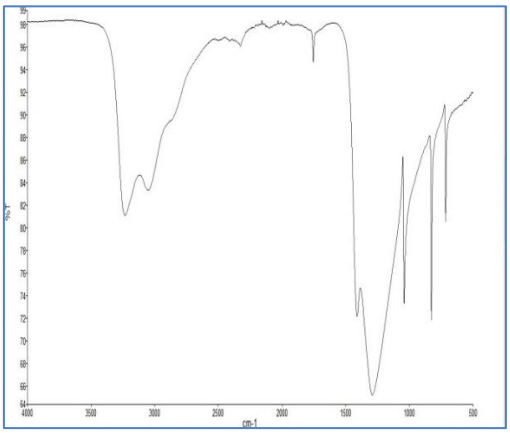


Figure 2: Analysis of 20 wt % Ammonium nitrate. [11]

5.3 Observations of Ammonium Nitrate using MQ135 Sensor.

5.3.1 Observation Table:

Table 3: Observations of Ammonium Nitrate material

Addition of water in ml	Output Voltage(V)
0	0.33
2	0.44
4	0.46
6	0.47
8	0.46
10	0.47
12	0.48
14	0.87
16	0.53
18	0.55
20	0.56
22	0.42
24	0.55
26	0.56
28	0.56
30	0.82
32	0.55
34	0.45
36	0.35

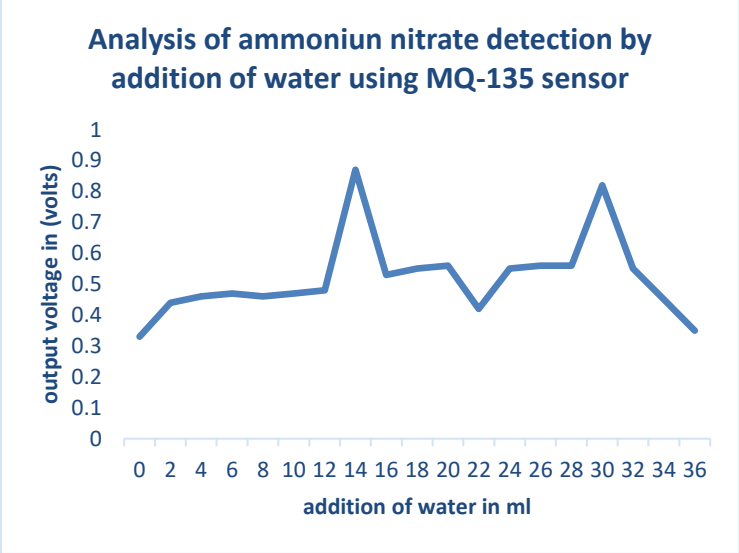


Figure 3: Graphical Analysis of ammonium Nitrate detection by adding of water using MQ-135 Sensor

5.3.3 Conclusion from graphical analysis of NH4NO3 using MQ135 Sensor.

We analysed that when we added water in ammonium nitrate the output voltage value suddenly increases as we see in the graph. As per FTIR Spectrum 2 Spectrometer and MQ135 Sensor we came

onto conclusion that observations taken were found to be in increasing ratio. So MQ135 sensor can also be used instead of Spectrometer. Hence it can be used in Bomb Disposal Robot.

6. CONCLUSION:

So, we are using MQ-135 sensor initially for basic testing, but we want to design an alternate sensor which will be cost effective, small in size and easily usable, which can be used instead of Spectrometer due to its huge in size, high cost and immovable features. The wireless Bomb Disposal Robot has been designed in such a way that it can cater to the needs of the bomb disposal squad, military and police who handles explosive materials. This robot by using its robotic arm will dispose the bomb either in bomb disposable container or at remote place. It has various applications and can be used in different environments and scenarios. For instance, in one place it can be used by the bomb disposal squad while at another instance it can be used for handling mines. Similarly, another application is such that itcan provide up-to-date information in a hostage situation.

7. Future Scope:

- Development of a digital sensor for Explosive material detection.
- Design and development of a smart robotic arm for lifting high-risk and explosive, material without involving human interaction, as well as the disposal of the bombs.
- Robots can be modified which easily work in remote areas.

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