BOMB DISPOSAL ROBOT

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Abstract— ***In the present work bomb disposal robot is designed and developed. It is equipped with an uprooted arm that allows it to enter hazardous areas and pick up disposable packages, making it an essential tool for bomb disposal teams. The robot includes a camera which facilitates the user to capture images and videos not just during day time but also at night. Furthermore, the robot is controlled using a wireless remote control, and its circuit comprises various segments that receive and process signals. The robot can be moved in directions, such as front, back, left, or right the operator using the commands through the remote control. The robot can also move in curved surface. In the present work Node MCU-ESP8266 and ESP32-Cam are used which are programmed using Arduino IDE. For the control of rover model and Robotic Arm a app is built which is built by MIT app inventor web application.***

Keywords *-Robot, rover model, Robotic arm, Node MCU/ ESP8266, Camera, Relay*

Introduction

The design takes into consideration of the current affairs like civil wars, military unsteadiness, and terrorist outbreaks around the globe with uncertainties of the future. Almost every day many trained cadets are injured or killed when they deal with bomb or attempt to defuse mine. Bomb disposal robots is a remotely operated machines designed to assist in the detection, evaluation, and disposal of explosive devices. These robots are typically used by military, law enforcement, and security agencies to protect public safety and property. Bomb disposal robots are an important tool in the fight against terrorism and other forms of violent extremism. The first bomb disposal robots were developed in the 1970s, in response to the growing threat of terrorist attacks. These early robots were large, bulky, and difficult to operate. However, advances in technology have led to the development of smaller, more agile robots that can be easily transported and operated by a single operator. The main purpose of the robot is to provide safety and security to the armed forces and bomb disposal squad against the dangers that they face day-to-day, that is in the course of their work. It has a wireless camera for video feedback, so the operators can run more efficiently. Using wireless segments, the robot can operate in a much larger area. This is to provide a more extensive range of operations, as well as the capability of being controlled from a distance. The robot takes danger out with minimal deadly eventualities. They could still be used to relay statistics to help in analysis in case its failures. Also, to construct a basic bomb disposal robot that can handle simple tasks like wire cutting, reversing switches, lifting light objects, approaching it for disposal etc.

Objective

- To design and fabricate the rover model which moves autonomously in linear and inclined path.
- To assemble and mount a robotic arm which operates with 4 servo motors which are designated as shoulder, elbow, base and gripper.
- To provide situational awareness to operators by placing camera module.
- To build a working webpage and app to control the arm and motors of the model, where it follows the direction according to given instructions.
- To build a robot capable of performing delicate tasks such as picking up small objects or removing specific components.
- The robot safe means to disposing of the explosive device. This ability includes to cut wires, remove fuses and even safely detonate the device if necessary.

Methodology

In this arrangement, the instructions are first transmitted to the receiver through the remote. These commands are then, processed and transmitted to the driver circuits which runs the motors.
The instructions are then dispatched to the digital camera's motor and the rear wheel's motors which then move accordingly. The photos obtained via the wireless digital camera is delivered in real-time to the capture card of the digital camera after which displayed.

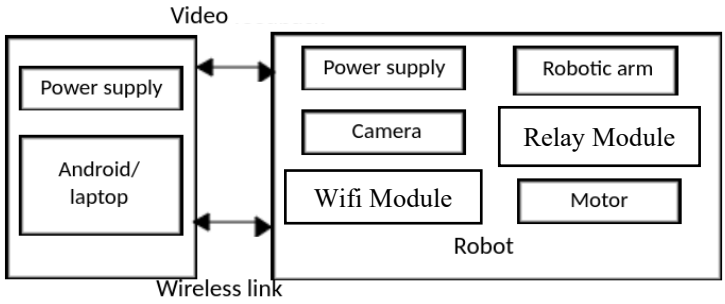

Fig 1.1: General operating methodology of Bomb disposal robot.

The circuit connections for this prototype is as shown below in Fig: 1.2 and 1.3 The NodeMCU-ESP8266 is used as a micro-controller to operate the DC motors and the robotic arm with the help of servo motors. The servo motors are connected to servo board with bug converter which works in an operating voltage of range of 5V. The DC motors are operated by connecting, the motors to the 5V Relay Module with Optocoupler.

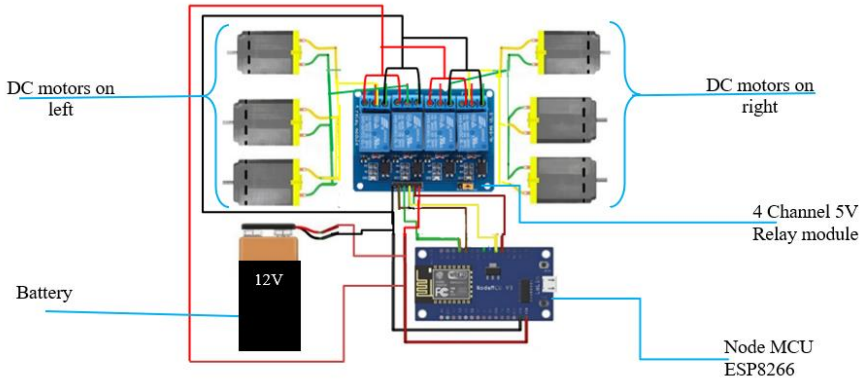

Fig 1.2: Circuit Diagram of connection between NodeMCU-ESP8266 and motors

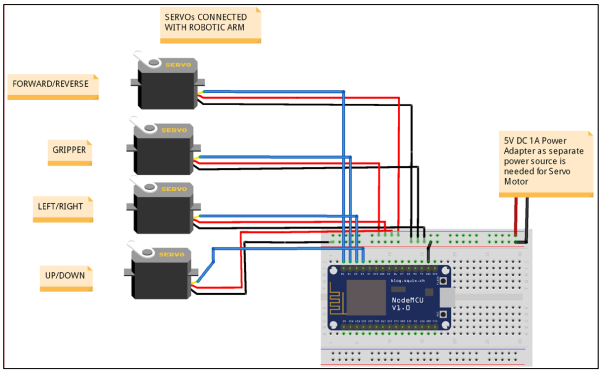

Fig 1.3: Circuit Diagram of NodeMCU-ESP8266 and servo motors

Whenever user clicks the button, an on-click method is called in JAVA and an http request corresponding to the button is sent, thereby the response is obtained. The DC motor is operated by 5V Relay Module with Optocoupler. The main role of an android-controlled bomb disposal automaton is carried out through its joints. Joints are analogous to human joints and are used to join two consecutive inflexible bodies in the robotic. They can be both rotary and linear. To add a joint to any link of a machine, we need to recognize the degrees of freedom and degrees of movement for that body part. Degrees of freedom put in force the linear and rotational motion of the body and degrees of movement implies the range of axis the body can move. The speed controls and arm servo motors are defined in this module relatively as shoulder, elbow, gripper and base. Additionally, the arm can be programmed to repeat the same sequence of movements, making it useful for repetitive tasks. Overall, a 4 DOF robotic arm offers versatility and precision, making it a valuable tool in many industrial and manufacturing applications. With the help of WIFI module we can generate SSID which can be connected to android or laptop through WIFI connection. The connected device provides access for control of DC motors and robotic arm through IP address given in serial monitor by IDE.

Result and Conclusion

The frame of rover model was completed by assembling the PVC pipes, joints, elbows and joined through nuts and bolts. The battery pack was installed and wired to power the motors. The wires were connected to the motors and the battery pack, making sure to follow the given instructions. The NodeMCU-ESP8266 Wi-fi module is connected to control the motors through 4 channel 5V relay module with optocoupler which supports all the four motors. The voltage is supplied through voltage regulator. Assembling the robotic arm according to the manufacturer's instructions. This involves attaching the servo motors, gripper, and screws to the arm. The robotic arm is placed on the rover model. The completion of the project has resulted in a successful outcome, meeting all the objectives outlined at the outset of the project. The robotic arm was able to successfully maneuver and manipulate the camera to capture images from the range rover model. The range rover model was also able to move around autonomously, further showcasing the capabilities of the robotic arm and camera system. A bomb disposal robot has been built. The robot can be controlled using either an Android phone or a laptop. A web page can be used to connect the phone or laptop to the robot's control system. Once connected, the robot's arm can be controlled through the web page. Overall, the project on the bomb disposal robot yielded promising results and showcased the potential of such systems for various applications. However, further research and development are necessary to optimize the system and address any potential safety concerns.

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Scope for Future-work

In future we can enhance the camera and add GSM/GPS module and use RF frequency control for proposed robot, which can be operated from different place and obtain the exact location. We can add another arm and use in mining or other hefty works with help of sensors. It can also be used as line follower with the help IR sensor.

1. AI-based decision making: Incorporating artificial intelligence algorithms can make the robot more autonomous and capable of making real-time decisions. The robot can be trained to detect and classify different types of explosives and devise the most appropriate disposal technique.

2. Wireless charging: Currently, most bomb disposal robots rely on batteries which need frequent recharging. By adding wireless charging capabilities, the robot can remain operational for extended periods without requiring manual recharging.

3. Multi-robot coordination: In complex bomb disposal scenarios, multiple robots may be required to work together to diffuse a bomb or clear a path. Developing a system for multi-robot coordination can improve efficiency and ensure that the task is completed safely.

4. Increased mobility: Bomb disposal robots are often limited in their mobility due to rough terrain or obstacles. Enhancing the robot's mobility capabilities, such as by adding wheels, tracks or legs, can improve its ability to navigate difficult environments.

5. Environmental sensing: In addition to detecting explosives, the robot can be equipped with environmental sensors to detect hazardous chemicals or gases. This can help first responders to evaluate the risks of the situation and determine the appropriate course of action.