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Automated Arm Robot for Intelligent Surveillance by Integrating Image Processing

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I.Abstract

Every day, news reports about trainees who have been hurt or army personnel who have died while defusing bombs circulate around the industry. Another significant issue in contemporary society is surveillance. The goal of the project is to build a robot car that can be operated by hand motions. The user can control the built-in robot manually and assist in resolving the aforementioned problems by using a computer and hand gestures. Using a wi-fi digital camera, the entity is checked to see whether it is a foreign object that can be further diffused and disposed of. The sensor turns ON when the detector detects the essence of the bomb, an unknown object, etc. In addition to gesture recognition, a helpful feature is manual control, which can be used in case of failure or in other circumstances. The general design of the robot is influenced by a variety of variables. A dedicated laptop is also utilized to manipulate all address configurations while Open CV is used to emulate the initial setup.

Keywords: Surveillance, Image Processing, EOD (Explosive Ordnance Disposal), Robotic Arm, HMI, Gesture Recognition, Open CV, Python, Arduino.

II.INTRODUCTION

The development of technology has led to the creation of various machines that help in the completion of difficult tasks. One such machine is the robotic EOD (Explosive Ordnance Disposal) system that is designed to aid in explosive ordnance disposal (EOD) operations, where the disposal of explosive devices can be extremely hazardous. The Robotic EOD system is an advanced machine that is designed to make EOD operations safer and more efficient. It is equipped with a range of features, including a high-resolution camera, an arm, and a gripper, that allow it to handle explosive devices safely and effectively.The remote control system is designed to provide the operator with precise control over the movement and actions of the machine, allowing it to be operated safely and efficiently. The ability to control the machine remotely has eliminated the need for the operator to be in close proximity to the explosive device, reducing the risk of injury or death. This EOD system is an advanced technology that has the potential to make EOD operations safer and more efficient. The machine's ability to handle explosive devices safely, combined with its remote control system, makes it a valuable asset in EOD operations. The remote control system is an innovative feature that has eliminated the need for the operator to be in close proximity to the explosive device, reducing the risk of injury or death. Overall, this technology is a significant step forward in the field of EOD operations and is set to have a positive impact on the safety of EOD operations in the future. The system uses a combination of computer vision and machine learning algorithms to recognize hand gestures and translate them into robot control commands.In the following sections, we will discuss the design and implementation of the hand gesture-controlled EOD system, including the hardware and software components, the hand gesture recognition algorithms, and the robot control interface.

III.LITERATURE REVIEW

[1] This paper discusses sixth sense technology, which uses natural hand gestures to control electronic devices. An Arduino board and electronic components were used to create a high-end robot that can be controlled using hand gestures. Image processing techniques were applied using OpenCV and Python tools.

[2] The goal of this paper is to design and implement a remotely controlled bomb disposal robot with a robotic arm that has four degrees of freedom. The robot was designed with locally available hardware resources to reduce costs. It can detect gas, fire, and obstacles, and can collect and carry dismantled bomb parts up to 10kg as evidence. The robot can be controlled through the internet, and a Python script was used to control it via a web server.

[3] This paper outlines the development of a gesture-controlled robotic arm using computer vision, sensors, and a controller. By controlling the robotic arm with gestures, it describes the breadth and depth of scaling robotic applications.

[4] The design and construction of a wireless gesture-controlled robot using an Arduino Lilypad CPU and Android software are proposed in this study. An Arduino microcontroller, an Adafruit motor shield, an HC-05 Bluetooth module, and an Android smartphone make up the system's hardware. The system's software consists of a Java application that runs on Android.

[5] This paper discusses the development of systems that are modular, flexible, redundant, and fault-tolerant. Robotics is used to automate the manufacturing process or task, providing sensor-based feedback to the robot arm. The paper focuses on picking and placing jobs from source to destination using sensors that track the motion of the human hand.

[6] In addition to describing a spatial scanning time-domain electromagnetic induction (EMI) sensor, this work also reports the findings of recent field tests using low-metal content anti-personnel and anti-tank landmines and buried metal landmines. The Electromagnetic Target Discriminator (ETD) sensor, created by the Johns Hopkins University Applied Physics Laboratory for the US Army CECOM/NVSED, is upgraded into the EMI sensor. Metal target decay periods have been measured using the spatial scanning ETD sensor.

[7] The paper discusses the design and implementation of a machine learning-based predictive maintenance system for industrial machinery. The system utilizes various sensors and data analysis techniques to identify potential faults in the machinery before they occur, allowing for preventative maintenance and reducing downtime.

[8] The paper discusses the use of robotic systems for explosive ordnance disposal (EOD) missions. The robotic platform is designed to reduce risk to human personnel by providing improved reconnaissance capabilities and the ability to dispose of explosives without direct contact. The robot features a hand gesture interface, manipulator arm, and dexterous gripper for removal of detonators.

[9] The paper describes the use of a robotic arm for detecting and disposing of explosives in a 100-meter radius. The robot is remotely controlled and features a metal sensor and wireless camera for

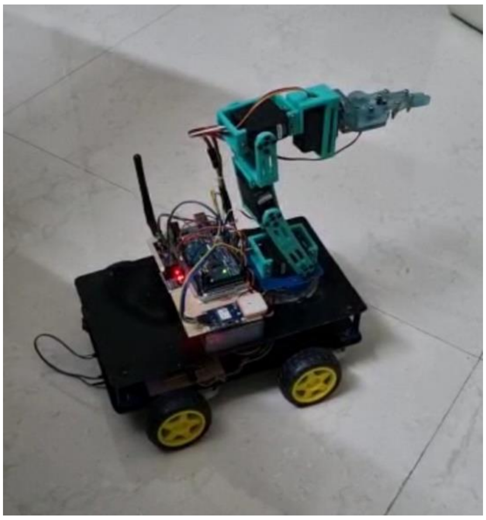
bomb detection. Proteus software is used for initial setup and a personal computer is used to control the hardware configuration. The robot is designed to reduce risk to bomb disposal crews and prevent casualties.

IV.PROPOSED SYSTEM

A camera and the Python HandDetector module are used to record user hand movements. All calculations are carried out by the software algorithm, and data is supplied to/received from the Arduino Uno and Mega through Bluetooth. Through the micro-controller board, other sensors, actuators, and display systems can also be connected. The robotic arm's motors are driven by the Arduino Board in turn. The proposed system offers several advantages over traditional EOD techniques, including faster response times, improved safety, and increased efficiency. By reducing the reliance on physical tools, the system allows EOD technicians to focus on the task at hand and respond quickly to potential threats.

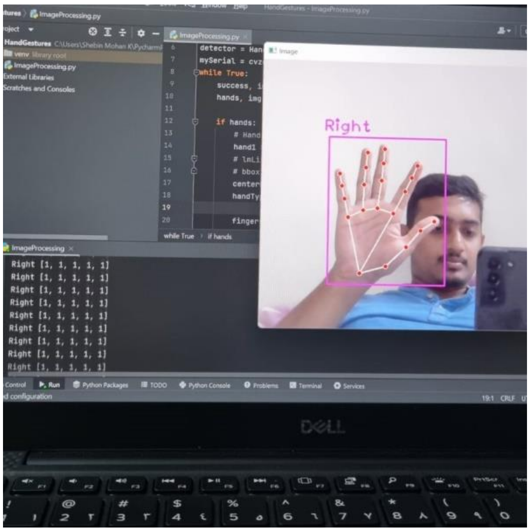
1. Hardware

The ATmega328-based Arduino UNO and arduino MEGA microcontroller outputs controlling voltage signals to the hardware. An external high-current DC power supply and the Arduino's 5V output pin power the hardware. The use of GPS (neo 6m) in EOD robots has a number of advantages, including greater navigational and mapping accuracy and increased operator safety. The Bluetooth NRF24L01 module is utilised for communication. It is a 2.4GHz transceiver module with great performance and low cost that is intended for wireless communication. Using camera-cp plus e24a, EOD specialists can approach dangerous locations from a distance and securely dispose of explosive devices by receiving real-time visual feedback from the robot's point of view. Each of them uses PWM to regulate speed and can operate two motors (MD 1501 MG). Three motor drivers were needed because the robotic arm has five motors.



2. Software

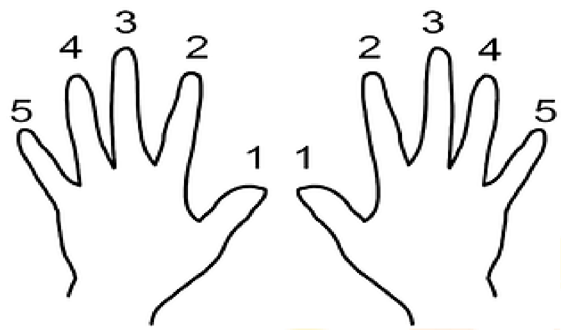
To wirelessly transmit serial data to an Arduino that supports Bluetooth, a computer's built-in Bluetooth module is used. Python has been connected to Arduino so that you can use the serial library to send data to the serial port. The right Python Run-time Environment was used with the Pycharm IDE for Bluetooth RXTX, and the Bluetooth serial port on the laptop was utilised in the code.



3. Gripper

The gripper on the robotic arm was trained to imitate each grasp and release motion made by the user.The angular aspects of the hands, such as roll, pitch, and yaw angles, were also taken into account to enable a more convincing duplicate of the user's arm. Similar arguments can be used to construct more complex systems with more degrees of freedom and better gripper configurations. To the Arduino Uno microcontroller, additional sensors, buttons, or display systems can be built.

4. Gestures



NO	Finger number	Hand	gesture
1	0, 0, 0, 0, 0	Right	SERVO 0 - R
2	0, 1, 0, 0, 0	Right	SERVO 1 - R
3	0, 1, 1, 0, 0	Right	SERVO 2 - R
4	0, 1, 1, 1, 0	Right	SERVO 3 - R
5	0, 1, 1, 1, 1	Right	SERVO 4 - R
6	1, 1, 1, 1, 1	Right	SERVO 5 - R
7	0, 0, 0, 0, 0	Left	SERVO 0 - L
8	0, 1, 0, 0, 0	Left	SERVO 1 - L
9	0, 1, 1, 0, 0	Left	SERVO 2 - L
10	0, 1, 1, 1, 0	Left	SERVO 3 - L
11	0, 1, 1, 1, 1	Left	SERVO 4 - L
12	1, 1, 1, 1, 1	Left	SERVO 5 - L
13	1, 1, 1, 1, 1	Left	Forward
14	0, 1, 0, 0, 1	Left	Backward
15	0, 0, 0, 0, 0	Left	Stop
16	1, 1, 0, 0, 0	Left	left
17	0, 1, 0, 0, 0	Left	right

V.FUTURE WORK

This robot is designed to assist in the safe disposal of explosive devices by providing remote access to hazardous areas. The purpose of this paper is to propose potential future work that can be done to improve this technology.

One possible area for improvement is the integration of advanced AI algorithms to enhance the robot's ability to understand complex hand gestures. Machine learning algorithms can be used to train the robot to recognize and respond to a wider range of hand movements, improving its overall functionality and effectiveness in the field.

Another important area of future work is the development of a more robust and reliable GPS system. The GPS system is essential to accurately track the robot's position and ensure that it can safely navigate its environment. Improved GPS technology can also be used to create more accurate maps of the area, providing valuable information to EOD technicians and first responders.

The arm and gripper system of the robot can also be improved to increase its functionality. For example, the development of a modular gripper system that can be quickly and easily swapped out for different types of grippers can enhance the robot's versatility. This will allow it to adapt to a wider range of situations and perform a variety of tasks.

The integration of sensors can also improve the robot's performance. For example, adding a thermal imaging camera to the robot can help identify potential explosive devices hidden in challenging environments, such as low light or heavily vegetated areas. Similarly, integrating gas sensors can help identify potential hazardous gases that may be present in the area.

The development of a user-friendly interface can improve the usability of the robot. A more intuitive interface that allows the operator to quickly and easily control the robot's movements and actions can make the EOD robot a more effective tool for first responders.

Finally, the project's future work may also involve better features like voice recognition, a wider bomb detection area, returning home in the event of a signal outage, and additional operational orders in accordance with the demands.

VI.CONCLUSION

One of the key advantages of EOD

systems is that they allow operators to perform potentially dangerous tasks from a safe distance, reducing the risk of injury or death. EOD systems can also be equipped with specialized sensors and tools, such as X-ray machines and disruptors, that enable operators to safely neutralize explosive devices without having to physically handle them. There are many different types of EOD systems available, ranging from small handheld devices to large, multi-featured robots. Some EOD systems are designed for specific tasks, such as bomb disposal, while others are more versatile and can be used for a range of applications.

One potential application of this technology is in manufacturing, where it can be used to automate various tasks such as material handling, assembly, and quality control. By using hand gestures, operators can quickly and easily program the system to perform specific tasks, reducing the need for extensive training and programming expertise.

In the agriculture industry, the integration of wheels, GPS, arm, and gripper with hand gesture control can be used to automate tasks such as planting, harvesting, and crop maintenance. The system can be programmed to navigate through fields using GPS and perform various tasks, such as picking up and moving fruits and vegetables, watering plants, and applying pesticides.

The logistics industry can also benefit from the use of this technology. The system can be used to automate tasks such as package sorting and loading, reducing the need for manual labor and increasing efficiency. Hand gesture control allows operators to quickly and easily program the system to perform specific tasks, reducing the time and cost required for training.

A human machine interface that deals with the intuitive operation of a robotic arm is suggested for the development of a remote EOD system. Overall, EOD systems play a critical role in ensuring public safety by allowing trained professionals to safely dispose of explosive devices and other hazardous materials. The suggested system can be used in a hazardous situation. Although the limitations of the materials reduced their effectiveness and dexterity, all systems operated as anticipated. Future developments may focus on programming the system to record the user's gestures and then replicate them with the arm.

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