Metal Detector & Bomb Diffusal Drone Based on Wireless Tramission

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Abstract*—One of the greatest threats for both police and military forces to handle is explosive devices. Bomb disposal teams require new robotic technologies to disarm explosives remotely, without human contact in order to keep bomb disposal experts safe. In this paper we discuss the tools & technology to develop a drone. This paper also shows a drone prototype for metal detection and defusing a bomb.*

Keywords*—bomb defusal, smart city, metal detector, IC , transmitter, receiver.*

I. Introduction

One of the greatest threats for both police and military forces to handle is explosive devices. In India itself there have been around 1920 fatalities in around 64 such incidents. Even when a device is found, disarming it is potentially dangerous and unpredictable. Robots are used in many cases to aid bomb squads, but they have many limitations. Current bomb disposal robots have grippers which allow the robot to open doors and access the explosive device; however, in most cases a human must put themselves in danger by disarming the device manually. To further reduce the risks associated with bomb disposal, robots must be developed that can actually disarm explosive devices. Figure 1 shows the basic pictorial overview of such system [1]

In dangerous situations, robots can replace humans by detonating a bomb or moving the device to a safer location where it can be detonated. This keeps people away from the bomb, but the bomb is still detonated. In addition to all of the problems of saving evidence this strategy also introduces different difficulties. The robot must be controlled remotely, making it difficult for the controller to see everything that is happening. Also, the robots have grippers which do not provide an effective grasp of the explosive. This is very apparent in a 2011 news story about the bomb squad in San Francisco. After finding a garage full of live, World War 2-era explosives, the bomb squad used a bomb disposal robot to carry the explosives to bomb experts, who disarmed the devices. While carrying one of the grenades, the robot dropped the explosive then drove over it. The news personnel were horrified, but the driver of the robot was completely oblivious to the incident. Luckily, the grenade did not detonate; however, it took the robot four more minutes to retrieve the bomb and hand it to an explosives expert who was able to disarm the device ("Clumsy! Bomb disposal robot", 2011). The gripper was unable to hold the bomb while carrying it out of a garage, and once it dropped the bomb, the robot took four minutes to pick it up again, showing deficiencies in the grasper. Even then, the robot did not have the capability to disarm the grenade; instead, it had to hand the explosive to a person to disarm it. This situation could have been very dangerous if instead of a grenade, the explosive had been a device with a timer. As it was, the clumsy robot placed the bomb squad in great danger when it forced the explosives expert to manually disarm a grenade that had been crushed by a robot. Because of the typical design of EOD grippers, the robot had to be positioned carefully to allow for a steady grasp. In this case, the grasp was not steady, leading to the robot dropping the device. The gripper design also made it difficult to retrieve the explosive after it had fallen. More complex grippers which have the ability to adapt their grasp to different objects can increase the stability of the grasp as well as make grasping objects faster and more reliable. (Massa, 2002)

This paper discusses a mechanism of building such a drone that that can detect the bomb the and also defuses it at the same time. Section II discusses the related work and systems developed in this area. Section III discusses technologies used to develop the drone. Section IV discusses the Implementation of the system.

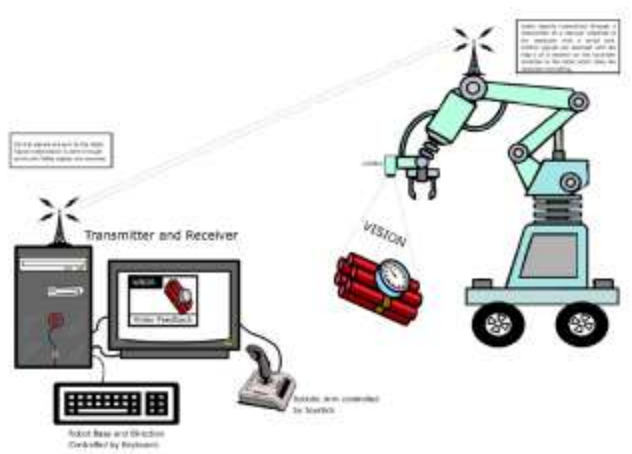


Figure 1

II. State of Art

Recent developments in robotics have yielded renewed interest in bomb disposal techniques and robots. There are two main goals in improving bomb disposal practices: to disarm the device with as little human contact as possible and to save the evidence contained in the bomb. In the past, the first problem has been solved by making robots that can detonate the bomb. This, however, works against the second goal because it destroys the evidence contained within the bomb that can provide law enforcement with the opportunity to find the maker of the bomb. To do this, the bomb must be disarmed without being detonated, a task which is currently almost entirely manual. There is a potential for vast improvement in the ability to accomplish these goals of bomb disposal by using new technology to improve bomb disposal robots and allowing humans to keep a safe distance from the explosives in more situations.

Intentionally detonating the device in a safe area is a strategy that is used often because it ensures that the bomb will not detonate in a dangerous area. If the bomb is in an area with nothing around it, an explosion is the fastest and easiest way to dismantle it. In other situations, the bomb can be moved to a location where the device can be detonated safely. This, however, leads to the challenge of moving the device. Timers or trip switches that are attached to the area around a bomb can make moving it difficult or impossible. If moving the device involves moving it closer to people, a remotely detonated device could decimate the bomb squad. Even when a device is safely detonated, the explosion destroys most of the evidence that could help law enforcement. This makes detonating bombs a perpetual method for eliminating bomb threats because the bomb makers are rarely caught. Additionally, every bomb that is found and detonated helps bomb makers learn how to make a bomb that hits its target instead of being dismantled (Lecher, 2012).

Currently, some specialized bomb disposal robots can eliminate this danger by disarming specific types of bombs. For instance, the SAPBER robot has a device that can remove the end cap from pipe bombs and allow bomb experts to examine the inner materials. This device, however, is very specialized to handle pipe bombs, and would be useless if the explosive was not a pipe bomb, or was made differently than traditional pipe bombs (Lecher, 2012). The challenge remains to make an effective bomb disposal robot that can disarm bombs with the same capability and adaptability as a human bomb expert.

In the same league we have teleMAX bomb disposal robot. The teleMAX bomb disposal robot has been specially adapted for operations that have to be carried out in narrow spaces, such as on aircraft, underground trains or buses. Anywhere where the larger model, tEOD or, cannot operate, teleMAX ensures that the vital distance is maintained between the bomb disposal engineer and the bomb. **Elmo's Whistle and Tweeter servo drives Controllers** are a very practical choice, as then can be mounted within the joints of the robotic arm.

III. Technology & Tools

A. ATMEL 89C52

The Atmel 89C52 microcontroller is used for the controlling the robot. We have termed it the brain of our robot. The reason for choosing this microcontroller is its reliability and availability. Moreover it has three data ports, which are used for controlling of the different components of the robot.

B. 5804B Stepper Controller

For the robotic arm we have used two uni-polar stepper motors. The 5804B is a uni-polar stepper motor controller, which generates all the necessary signals to control and run the stepper motor. It also has an enable pin for turning on/off the motor and a direction pin for changing the direction. Using the IC saves the number of port pins of the microcontroller, which can be used for other purposes. It also provides the appropriate current (maximum 1.2A), which is required to generate the appropriate torque by the motor.

C. Relays for DC Control

A 12volt DC relay is used to control the DC motor from the signals of the microcontroller. A 12volt relay instead of a 5volt relay has been used to provide isolation to the microcontroller from the DC motor, which can damage the controller by drawing large current.

D. ULN 2003

The ULN2003 Darlington array IC has been used for interfacing between low-level logic circuitry and high power loads, the DC Motor.

E. MAX 232 Level Converter

The serial port works on voltage levels of the RS232 format, which are different from the TTL (0 and +5) voltage levels. The MAX232 level converter has been used for inter-conversion between these voltage levels.

F. HT12E Wireless Transmitter

The HT12E wireless transmitter has been used to transmit serial data from the control application, over a wireless link using radio frequency, to the robot. The reason for choosing for an off the shelf module for wireless transmission, is to save time and cost. By using this transmitter a lot of time and energy have been saved, and reliability has increased.

G. HT12D Wireless Reciever

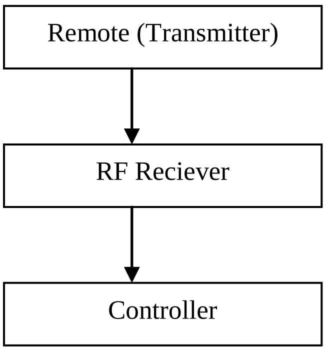
The wireless receiver has been used in conjunction with the wireless transmitter to receive serial data transmitted by the control application. The receiver is connected to the microcontroller, which receives the serial data over its serial port.

H. DC Motor (High Torque 100 RPM)

The DC motor has been used to control and move wheels of the drone.

IV. Implementation Architecture

The system is designed to be controlled using wireless remote by using IC HT12E & IC HT12D which is connected with microcontroller. The transmitter sends the signal to the receiver. Receiver receives the signal and reads the data and passes it controller's designated pin. The controller then reacts according to the signal received by the RF receiver. The block diagram for the same has been shown below:



A. Robotic Architecture

1) Joystick Interface Module

This module is used for the control and actions for the robotic arm, which is controlled by the joystick and the changes occurring with the movement of joystick results in the different movements of the robotic arm.

2) The Robotic Base

The base is made of wooden plywood with wheels attached through clamps. The wooden base was used to avoid electric shocks that could damage the drone. The supporting beams were clamped to support the platform on top of the structure of the base. The base consists of the following mechanisms that are responsible for driving and turning:

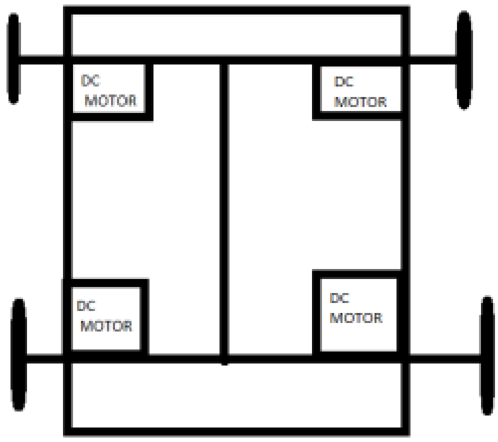


Figure: Robotic Base Structure

3) Driving DC Motor

The Driving DC is a 24volt DC motor that is connected to the rear axle using a sprocket and chain. Torque from the DC motor is transferred to the axle using this chain.

Various parts of the system can be viewed in the figures below:

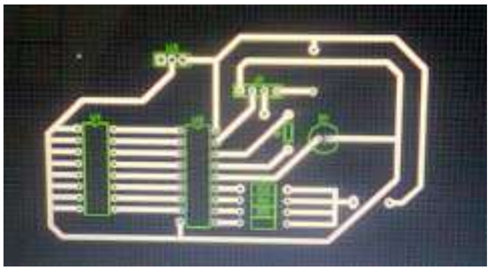


Figure: PCB Design for the Decoder

Figure: Encoder

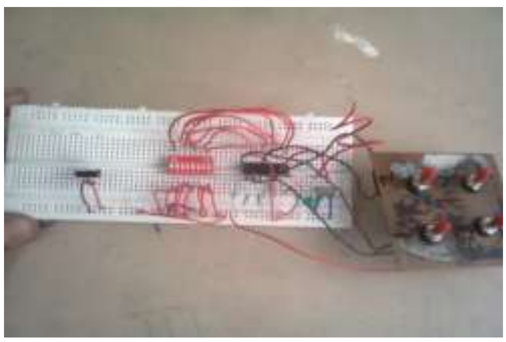


Figure: Transmitter Joystick Controller

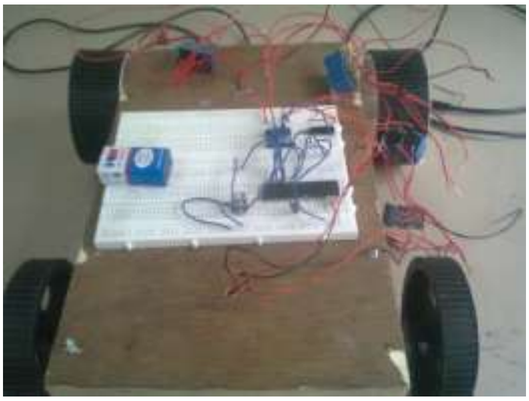


FIGURE: DRONE MODEL PROTOTYPE

CONCLUSION

In this paper we have discussed the importance of the drones in bomb defuse. This paper discusses various tools and technologies for developing such system and also shows the basic implementation of a drone. The drone is also having the feature of metal detection and is controlled wirelessly effectively.

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