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IOT Based Bomb Disposal Robot

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Abstract: *This paper is presenting two technologies which when combine together can form an tremendous useful devices for the defense system and ultimately an society because robot is an unique technology to serve society in the different application and in different field so we all know the important of robot now days in society and developing technology the number of robots used worldwide is rapidly increasing. They are more and more present in different workplaces such as, military, processing operations, dangerous areas, medical environments, manufacturing inaccessible areas etc. We also have one unique communication technology now which is called as Internet Of Things. This paper will explain mostly this IOT technology because IOT is not only just an technology it is an is phenomenal. Now a days the Internet is being used to connect various objects such as sensors, cars, machinery, controllers, TVs, transport containers and electrical appliances, creating the Internet of Things (IOT). The networked and the user interfaced robots, such as the rescue robots, human assisting robots, health care robots and the robots for military applications .The evolution and growth of the Internet because of a technology we can control the robot with high distance, high speed and high accuracy, solution on all communication and controlling over the internet which is totally wireless and we can optimistically look forward to IOT-assisted world that is connected, smarter – and better. Disposing of any explosive materials is an extremely dangerous and the risky job .bomb disposal is also an extremely delicate job. The project has been designed for keeping in view the current law and order situation in throughout the world. Everyday hundreds of the trained soldiers are either injured or lose their lives while defusing the bombs and for that we can use robot for disposing the bomb and can save lives of our large number of human beings.*

Keywords: *IOT (Internet Of Things, Wi-Fi device, DC, TCP, EOD).*

INTRODUCTION

Everyday hundred of the trained personnel are either injured or lose their lives while defusing the bombs. This can be reviewed by the large number of news items appearing daily in newspapers and other media around the world. The bomb disposal squad of an INDIA has the metal detectors and other material for the bomb detection and disposal, but they have risk to their lives by approaching the bomb or the suspicious packet without any safety and the precautions.

The robot provides an extra layer of protection to the bomb disposal squad by allowing them to check and to analyze the packet before actually approaching it for the disposal. The main idea behind this robot is to provide the line of defence to a bomb disposal squad against the life-threatening risk, faced by them in the event of an explosion. It provides the squad of safe distance to dispose of a bomb, which normally is done with the bare hands. It is designed as an assistant robot. This system makes use of robotic arm as well as robotic vehicle which helps not only to enter an area involving the high risk but also to pick whatever object it wants. The system also includes camera which will not only allow viewing whatever will be recorded in day time but also at night. The whole system is controlled via android application. The system sends commands to the receiving circuit mounted on vehicle through the android device application. The receiving circuit involves the ATmega32 and a Wi-Fi device which receives commands sent by an webpage application.

LITERATURE SURVEY

Now a days, IOT technology is taken granted for most of the controlling applications like medical, defence, automobile, industrial project, smart cities and many more. It has been considered as an another technological revolution. Internet of Things (IOT), also called as an Industrial Internet, has been defined as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on the existing and evolving interoperable information and the communication technologies. Large number of the applications and controller can get connected to the IOT network. So with the help of IOT technology DEFENSE system also can get an advance defence device in the form of BOMB deposing ROBOT. As , disposing of bomb is the big task for human being there is always risk of loss of life in case any mistake is done by the human that's why robotics technology can give solution to this problem and with the help of robot it is possible dispose the bomb. Now the question arises here how we can control robot? there are huge number of technologies to control robot these are wireless or wired again they get divided into some technology in wireless like 1) GSM control 2) Bluetooth 3) Wi-Fi 4) RF control and much more but all this technology have some advantages and some disadvantages too. So rather than use of this all we can go with IOT (Internet of Things) a new trend of communication and controlling .This has an lots advantages during controlling.

There are some projects that have been completed which regards to the application of the IOT based bomb disposal robot.
For the following project we have gone through various reference papers as such.

1)The Kinematic analysis and simulation of 6 D.O.F. of robot for industrial applications. An alternative design of six-degrees-of-freedom manipulator based on the concept of an in parallel actuated mechanism is presented. They have used robot analyzer software for determining a simulation results. Many possible applications which include the in-parallel mechanism as a part of an manipulation system are suggested, and also to determine the D.H. Parameters for design. The manipulator are derived and the influences from the physical constraints on range of motion in the practical design is discussed. [5]

2) This paper describes an visual display that provides the depth of an objects to be grasped and was developed as the request of the local bomb squad for use with the bomb disposal robot. The display provides the four main functions: (1) it allows an operator to extract the distance between an object and the robot's grasper that each pixel represents, (2) it cues the operator when the object is within an predefined distance from the robot grasper, (3) it can track the object in the video display, and also (4) it can continuously display the distance from the robot grasper to a selected object. The display was designed specifically for the Canesta EP200 mounted on a Remotec mini-max robot, but the display functionality is expected to be useful for any of the robot grasper used in conjunction with a 3D sensor. The usability of the visual display and its impact on grasper-related performance has not been formally evaluated, the informal feedback from subject matter experts is that this display meets their specified requirements.[9]

Block Diagram of Project

Block Diagram

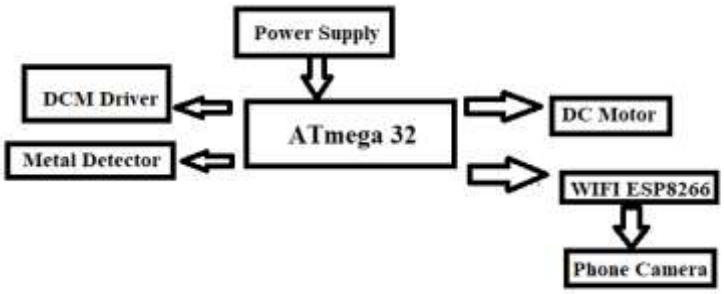

Fig Block Diagram.

Block Diagram of System.

The Proposed system consist of:

- ATmega 32.
- DCM Driver.
- DCM Motor.
- WIFI ESP 8266
- Phone camera
- Power Supply

A. Description of a proposed system.

This project consists of a mobile robot which shall be consisting of a base with 4 wheels, one vertical post and on the vertical post the horizontal beam shall be mounted. On the horizontal beam an assembly consisting of 2 DC motors can be moved forward and backward. Finally, a pulley with one DC motor shall be moving up and down. If you are available anywhere, we can connect TCP Server to the mobile crane. There shall a server running on PC. Using This server, I can carry out following activities. We can fit a mobile camera on Crane which can show live footage on PC using through WiFi. The main goal of this project is to provide safety to the bomb disposal squad by providing an extra line of the defense. Provide the remote monitoring and controlling application for analysis of an suspicious packet (or bomb). Allow the user to manipulate an packet using the robotic arm. To provide the visual feedback from the site of the packet. To provide a very user-friendly control application. We are going to interface of camera so for future purpose

that images capture by camera of bomb will be more useful. Here we use an robotic arm which have 5 degree of freedom so that the operation of robot handling will be more easy and flexible.
To construct a basic bomb diffusing robot which can handle simple tasks like cutting the wires, flip on the switches, lift light objects, etc. and the simple autonomous robot to help in the transit of the bomb. Also gives the video feedback to us so that effective handling of an robot can be possible; this paper details the design and implementation of an intelligent explosive ordinance disposal (EOD) robot to provide an law enforcement agencies with the cost effective and Due to this more security will provide to bomb disposal squad. Also, it is more applicable for the police, nuclear radioactive material handling, also for the military purpose. We are going to use stepper and the Dc motors as actuator. Robot base will rotate up to 360-degree, elbow, shoulder and gripper also will move according to their directions of input to the system is from the user. This input is first processed at the control application, serially transmitted over the Radio Link. This input is then received at the robot and again processed further. The output of the system is an processed signal to the particular appropriate module. This module can be an motor of the base of the robot or the robotic arm.

Model Designing Steps:

- Determining power Supply
- Design power supply
- Choosing the Sensors
- Choosing the Microcontroller

Power Supply

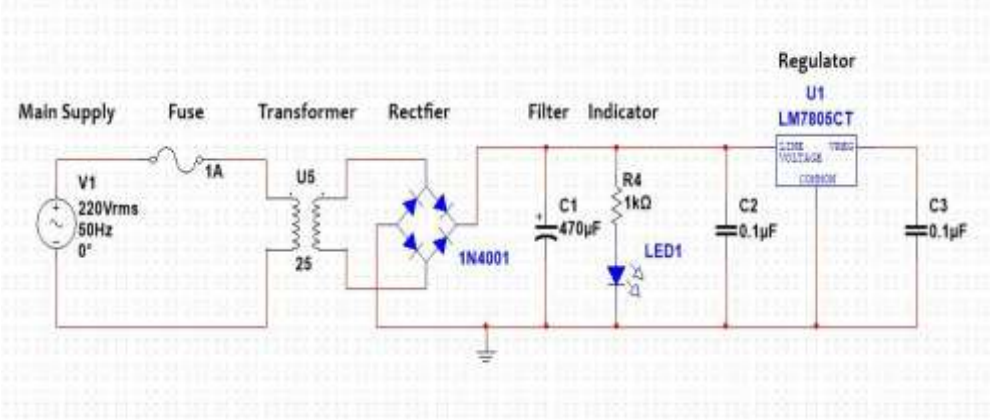

Figure : Circuit Diagram of Power Supply

Step 1: The Selection of Regulator IC

The selection of an regulator IC depends on the output voltage. In our case, we are designing for the 5V output voltage, we will select an LM7805 linear regulator IC. Next thing is, we need to know the voltage, current and the power ratings of selected regulator IC. This is done by using the datasheet of the regulator IC.
The Datasheet of 7805 also suggests to use a 0.1µF capacitor at the output side to avoid the transient changes in the voltages due to changes in load. And a 0.1µF at the input side of the regulator to avoid an ripples if the filtering is far away from the regulator.

Step 2: The Selection of Transformer

The right transformer selection means saving large amount of money. We know, that the minimum input to our selected regulator IC is 7V. So, we need an transformer to step down the main AC to at least this value.
But, between the regulator and the transformer, there is the diode bridge rectifier too. A rectifier has its own voltage drop across it, i.e. the 1.4V. We need to compensate for this value as well.
This means we should select the transformer with the secondary voltage value equal to 9V or at least 10% more than the 9V. From these points, for the 5V DC power supply design, we can select an transformer of the current rating 1A and secondary voltage of 9V or 12V.

Step 3: The Selection of Diodes for Bridge

The rectifier is made by arranging the diodes in some pattern. To make the rectifier we need to select the proper diodes for it. When selecting the diode for bridge circuit the output of load current, and the maximum peak secondary voltage of the transformer i-e 9V in case.
Instead of the individual diodes, you can also use one individual bridge that comes in the IC package. But I don't want you to use here, just for the purpose of learning and playing with the individual diodes.
The selected diode must have an current rating more than the load current. And peak reverse voltage (PIV) more than the peak secondary transformer voltage.

We select IN4001 diode because it has an current rating of 1A more than our desire rating, and the peak reverse voltage of 50V

Step 4: The Selection of the Smoothing capacitor and Calculations

While selecting a proper capacitor filter are, its capacitance value, power rating, voltage and. The voltage rating is calculated from the secondary voltage of a transformer. Rule of thumb is, the capacitor voltage rating must be at least 20% more than the secondary voltage. So, if the secondary voltage is 17 V (Peak value), then your capacitor voltage rating must be at least 50V.

Second, we need to calculate the proper capacitance value. It depends upon the output voltage and the output current. To find the proper value of capacitance, use the formula below:

$$C = \frac{I_o}{2\Pi f V_o}$$

Where,

Io = Load current i-e 500mA in our design, Vo = Output voltage i-e in our case 5V, f = Frequency

In our case:

Frequency is 50Hz because in our country mains the AC is 220 @ 50Hz. You might have 120V @ 60Hz mains AC. If it is, then put the values accordingly. Then by using the capacitor formula, the practical standard close to this value i-e 3.1847E-4 is 470uF.

Another important formula from the book of "Electronic Devices by Thomas L. Floyd" is listed below. This can also be used to calculate the capacitor value.

$$C = \frac{5(}{2\times\Gamma} C = \frac{2+(Rf)}{2(Rf)fR} 347\times10^{-4}$$

In this case, R is the load resistance. And Rf is the ripple factor, which should be less than 10% for the good design. And with this, we just finish the designing 5V power supply.

The implementation of a robotic systems which can move as the way humans do, with respect to the agility, stability and precision, is a important prerequisite for the successful integration of robotic systems in human environments. We explain human-centered views on robotics, based on the three basic ingredients (1) actuation; (2) sensing; and (3) control [11]

When comparing with the system that was mentioned in our base paper, our system is equipped with 2 wheels and a free wheeling motor, the system consist of 5 DC motors and 3 DCM driver and a arm cutter which is all controlled by our processor ATmega32 with WIFI module that is WIFIESP 8266. So, our system is able to diffuse the bomb at the site itself. And the design of our robot system is in such way that it is able to move Forward, backward, right, left. The arm of our system is designed in such a way that we can easily locate the target clearly and cut it precisely with commands such as cut and uncut. These all required commands are being applied through a web page that is accessible to any phone. The mobile phone placed on the system uses IP cam application which helps in guiding the robot at a distance. With the help of this technology we can make our robot travel particular distance without actually carrying the robot. The images could be captured by the person sitting at a distance from the attack prone area.

METAL DETECTOR

A metal detector is an instrument, which detects the presence of metal nearby. Metal detectors are useful for finding the metal inclusions hidden within the objects, or the metal objects buried underground. It often consists of an handheld unit with the sensor probe, which can be swept over the ground or the other objects. If the sensor comes near an piece of metal this is indicated by the changing tone in earphones, or the needle moving on an indicator. Usually the device gives some indication of the distance; the closer the metal is, the higher the tone in the earphone as higher the needle goes. Other common type is an stationary that the "walk through" metal detectors used for the security screening at an access points in the prisons, the courthouses, and the airports to detect the concealed metal weapons on a person's body. The simplest form of an metal detector consists of the oscillator producing the alternating current that passes through the coil producing an alternate magnetic field. The piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and thus this produces the magnetic field of its own. If other coil is used to measure the magnetic field (acting as a magnetometer), than the change in the magnetic field due to an metallic object can be detected.

DC MOTOR

The most common types rely on the forces produced by the magnetic fields. Almost all types of the DC motors have some internal mechanism, either the electromechanical or the electronic, that is to periodically change the direction of an

current flow in part of the motor. DC motors were the first type is widely used, since they could be powered from the existing direct-current lighting power distribution of systems. A DC motor's speed can be controlled over the wide range, using either the variable supply voltage or by changing a strength of current in its field windings. Small DC motors are used in the tools, toys, and the appliances. The universal motor can operate on the direct current but is a lightweight brushed motor used for portable power tools and the appliances. Larger DC motors are used in the propulsion of electric vehicles, elevator and the hoists, or in the drives for steel rolling mills. The advent of the power electronics has made replacement of the DC motors with AC motors possible in many of the applications.

Fig. DC Motor

OSCILLATOR

A oscillator circuit that uses an mechanical resonance of an vibrating crystal for the piezoelectric material to create the electrical signal with the precise frequency. This frequency is often used to keep track of the time, as in quartz wrist watches, to provide an stable clock signal for the digital integrated circuits, and to stabilize the frequencies for the radio transmitters and receivers. The main common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as the crystal oscillators, but other piezoelectric materials including the polycrystalline ceramics are used in the similar circuits. A crystal oscillator, particularly one made of the quartz crystal, works by being distorted by an electric field when voltage is applied to the electrode near or on the crystal. This property is known as the electrostriction or inverse piezoelectricity. When the field is removed, the quartz - which oscillates in the precise frequency - generates the electric field as it returns to its previous shape, and this can generate the voltage. The result is that the quartz crystal behaves like an RLC circuit.

Fig. Crystal Oscillator

WIFI MODULE

ESP8266 is the Wi-Fi SOC (system on a chip) produced by the Espressif Systems. It is the highly integrated chip designed to provide the full internet connectivity in a small package. ESP8266 can be used as an external Wi-Fi module, using an standard AT Command set Firmware by connecting it to any microcontroller using the serial UART, or directly serve as the Wi-Fi- enabled micro controller, by programming the new firmware using the provided SDK. The GPIO pins allows the Analog and Digital IO, plus PWM, and SPI, I2C, etc. The board has been around for almost an year now, and has been used mostly in the IoT contexts, where we want to add connectivity for example to an Arduino project. A wide adoption has been facilitated by very modest price, ranging from 2.50 to 10 USD depending on the features offered by the manufacturer.

Fig.Wi-Fi Module

Test Results

The main goal of the project is to provide safety to the bomb disposal squad by providing an extra defense protection. Provide a remote monitoring and controlling the application for analysis of the suspicious packet (or bomb). This also allows the user to manipulate the packet using the robotic arm. Because of this it provides visual feedback from an site of the packet. To provide a very user-friendly control application.
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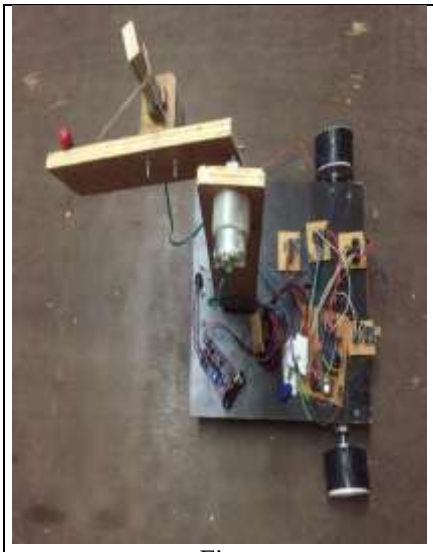

Fig .a

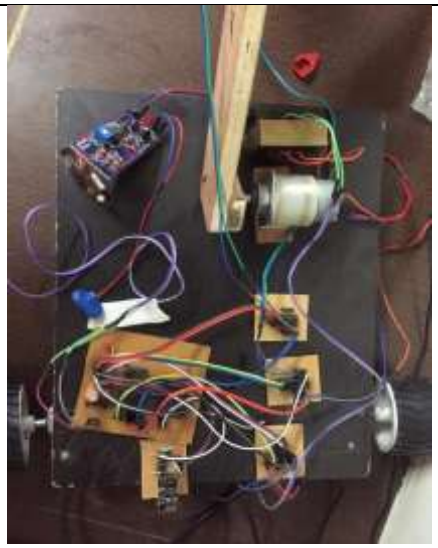

Fig. b

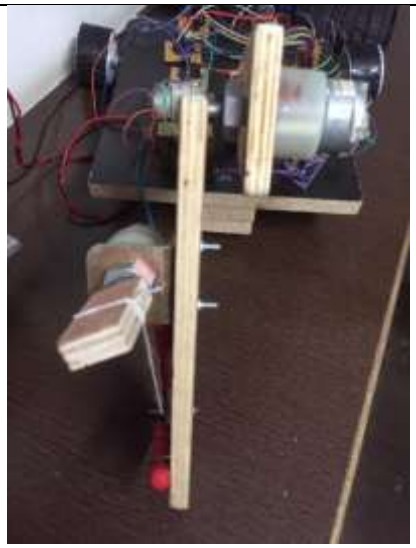

Fig. c

Conclusion

Mainly, the controls for these robots were difficult, requiring the specific training, now games console controllers are being used to operate them. “The prerequisite, in such high pressure environments, is to make the controls as intuitive and as easier as possible,” “You can put large number of functionality, but it needs to be operated by a typical layman and not a robotics. It would literally be like the joystick or the game controller.” Rather than using a single robot, function-specific robots are also being developed. These will operate together in teams, where one robot is tasked with sniffing out the explosives and another with its disposal. As the technology behind the bomb disposal robots improves, so it has the number of lives they have saved. “One of the target environments, in terms of use of robots, is for going into the dangerous situations,” Robots can go in, be operated from the very safe distance, and, in a worst-condition, be sacrificed.” So, we would like to conclude through the paper that implemented a robot for disposal of explosive ordinance with wireless video/audio camera is successfully designed, fabricated, tested and proven to be capable of performing the actions of what an explosive disposal robot is needed to perform. Further extension could focus on the limitation of materials and programming to increase and improve more gestures.

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