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Bomb Detection By Hexapod Robot

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I. ABSTRACT:

Now-a-days, automated systems have less manual operations and are more flexible, reliable and accurate. Due to these advantages every field prefers automated control systems. Especially in the field of electronics automated systems are giving good performance. In the present scenario of war situations, unmanned systems plays very important role to minimize human losses. Hence this project aims at making an unmanned vehicle for detection of bombs and other obstacles especially in terrain areas.This design of this project uses different mechanical and electrical components like microcontroller, encoder, decoder, IR transmitter and receiver, obstacle sensor, driver unit, motors and a robot model.The robot legs are fabricated into c-shape so as to provide easy traverse of the robot in areas like sand, granular areas and in water.

The c-shaped legs also provide larger thrust and lift force during its motion. A sensor is installed on the front part of the robot to sense any obstacles coming in its way. The movement of the robot is controlled remotely.Transmission section consists of keypad, encoder and an IR transmitter. The keypad consists of a set of keys which controls the direction of the robot. When any key is pressed in the keypad, the corresponding signals are encoded in the encoder and are transmitted through the transmitter.Receiver section consists of receiver, decoder, microcontroller and a robot with sensor mechanism.

The receiver receives the signal and sends it to the decoder circuit where the signal is decoded into original signal which is then given to the microcontroller.The microcontroller is programmed. Hence it receives the signal from the decoder and activates the corresponding driver circuit. The driver circuit controls the motor by which the robot movement is detected. If the robot comes across any obstacle, the sensor mechanism sends signals to the microcontroller by which the alarm is activated.

II. INTRODUCTION:

Soldiers in the Indian Military, as well as the military forces of other countries, are put in harm's way every day in conflicts around the world. Two of the main hazards they face, outside of actual enemy fire, are landmines and roadside bombs. With the technology that has been developed recently, these bombs can be detected by robots that are able to detect the bomb and move it to a safe location, out of the path of military units.The world is littered with mines and roadside bombs from current and past conflicts. Even though human troops can navigate these minefields as carefully as possible, they are not always successful and a mine or bomb goes off, causing several injuries and deaths. By using a bomb sniffing robot to find these mines, troops do not have to navigate and face peril when crossing these stretches of land. The same can be said for roadside bombs planted by enemy forces.

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These can cause injuries and death to troops, as well as damage to military vehicles. By checking roads for these and moving them to secure locations, or disarming them, military people are kept out of harm's way.There is an increasing need for robots to traverse a diversity of complex terrain. Platforms have been developed that can effectively run on fractured rigid ground, crawl within concave surfaces, and climb on walls. However, relative to biological organisms, small vehicles often have poor locomotor ability on granular substrates like sand and gravel. For example, in wheeled and tracked vehicles, wheel slippage and sinkage can cause significant performance loss.

III. LITERATURE REVIEW:

THE OPTIMIZATION OF LEGGED ROBOTS

Manuel Fernando Silva ,JA Tenreiro Machado

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Over the last two decades the research and development of legged locomotion robots has grown steadily. Legged systems present major advantages when compared with 'traditional' vehicles, because they allow locomotion in inaccessible terrain to vehicles with wheels and tracks. However, the robustness of legged robots, and especially their energy consumption, among other aspects, still lag behind mechanisms that use wheels and tracks.

RHEX: A BIOLOGICALLY INSPIRED HEXAPOD RUNNER

R. Altendorfer , N. Moore , H. Komsuoglu , M. Buehler , H.B. Brown , Jr. D. McMordie , U. Saranli , R. Full , D.E. Koditschek .RHex is an untethered, compliant leg hexapod robot that travels at better than one body length per second over terrain few other robots can negotiate at all. Inspired by biomechanics insights into arthropod locomotion, RHex uses a clock excited alternating tripod gait to walk and run in a highly maneuverable and robust manner.

DEVELOPMENT OF HEXAPOD ROBOT WITH MANOEUVRABLE WHEEL.

Mohamed Kassim and Annisa , Jamali International Journal of Advanced Science and Technology, 49. pp. 119-136. ISSN 2005-4238 . Hexapod robot is one of the robots used in this situation because of its stability and flexibility during the motion on any type of surface. Hexapod robot is a robot that has six legs to walk or move. Since the robot has many legs, the robot is easily programmed to move around because it can be configured to many types of gait such as alternating tripod, quadruped and crawl.

Dept. of Electr. & Syst. Eng., Pennsylvania Univ., Philadelphia, PA, USA H. Komsuoglu ; D. E. Koditschek. We report on a hybrid 12-dimensional full body state estimator for a hexapod robot executing a jogging gait in steady state on level terrain with regularly alternating ground contact and aerial phases of motion. We use a repeating sequence of continuous time dynamical models that are switched in and out of an extended Kalman filter to fuse measurements from a novel leg pose sensor and inertial sensors.

Our inertial measurement unit supplements the traditionally paired three-axis rate gyro and three-axis accelerometer with a set of three additional three-axis accelerometer suites, thereby providing additional angular acceleration measurement, avoiding the need for localization of the accelerometer at the center of mass on the robot's body, and simplifying installation and calibration.

We implement this estimation procedure offline, using data extracted from numerous repeated runs of the hexapod robot RHex (bearing the appropriate sensor suite) and evaluate its performance with reference to a visual ground-truth measurement system, comparing as well the relative performance of different fusion approaches implemented via different model sequences

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ROTATIONAL LEGGED LOCOMOTION

D. M. Lyons ; Robotics & Comput. Vision Lab., Fordham Univ., Bronx, NY ; K. Pamnany. In this paper we presented a novel, agile robot mechanism, which we call a rotopod, which combines aspects of wheeled and legged locomotion. A general description of how a tripedal rotopod can be made to step, rotating the mechanism about one leg, and moving the center of the mechanism, is presented. The concept of a gait for this mechanism is defined, and is used to show how extremely agile the mechanism can be. Specific resistance is employed as a way to explore the relative efficiency of this mechanism versus a wheel. Finally, we describe our first prototype rotopod and report on experiments conducted to characterize stepping.

IV. PARTS AND ITS WORKING: DESIGN & FABRICATION

MOTORS :

This project is a combination between software and hardware. The hardware of Vacuum Robot consists of the microcontroller, the motor, the vacuum, the sensors, the power distribution and also the chassis for the robot. software subsystem is the brain of the robot. Software part consists of microcontroller, arduino boad, relays, MikroC and Proteus is used to write the programming and simulate the circuit design. Microcontroller, Power Supply, Sensor, Motor, Relays, Batteries, Car Vacuum, Chassis, Wheel, Battery (12 v), Caster Wheels, Sweeper, Tyres

Table 3.2.1: Specifications

S.no	Product	No
	C shaped legs	6
	Dc motors 5kg, 200rpm	6
	Arduino	1
	Relay	8 channel
	Battery (12 v)	1
	Led	3
	Obstacle sensor	1
	Bomb dectection sensor	1
	Bluetooth device	1

If external power is applied to a DC motor it acts as a DC generator, a dynamo. This feature is used to slow down and recharge batteries on hybrid carand electric cars or to return electricity back to the electric grid used on a street car or electric powered train line when they slow down. This process is called regenerative braking on hybrid and electric cars. In diesel electric locomotives they also use their DC motors as generators to slow down but dissipate the energy in resistor stacks. Newer designs are adding large battery packs to recapture some of this energy

MICRO CONTROLLER :

Arduino is common term for a software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment(IDE) based on a programming language named Processing which also supports the languages C and C++.

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AURDINO:

An Arduino board consists of an Atmel 8-bit microcontroller with complementary components to facilitate programming and incorporation into other circuits. Official Arduino have used the mega AVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560. Most boards include a 5 volt linear regulator and a 16 MHz crystal oscillator or ceramic resonator in some variants.

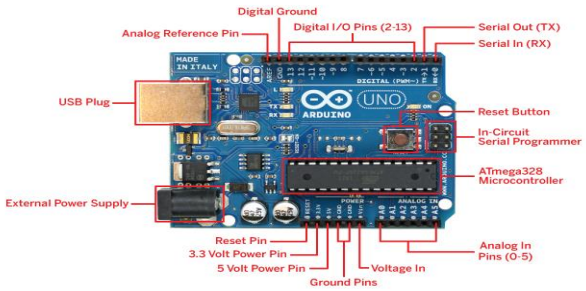

Fig:2Aurdino

An Arduino microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chipflash memory, compared with other devices that typically need an external programmer. This allows an Arduino to be used by novices and experts alike without having to go through the difficulties first faced by many when using electronics by allowing the use of an ordinary computer as the programmer. At a conceptual level, when using the Arduino software stack, all boards are programmed over an RS-232 serial connection, but the way this is implemented varies by hardware version.

Current Arduino boards are programmed via USB, implemented using USB-to-serial adapter chips such as the FTDI FT232. When used with traditional microcontroller tools instead of the Arduino IDE, standard AVR ISP programming is used. Arduino board provides 14 digital I/O pins, six of which can produce pulse-width modulated signals, and other six analog inputs. The output or inputs can be taken from the boards or given to the board using convenient connectors. Both digital and analog inputs and outputs are available in all Arduino boards.

The arduino boards can also communicate with other devices using standard communication ports like USART, IIC, and USB etc.

RELAY :

Relays are simple switches which are operated both electrically and mechanically. We know that most of the high end industrial application devices have relays for their effective working. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

OBSTACLE SENSOR :

The basic concept of IR(infrared) obstacle detection is to transmit the IR signal(radiation) in a direction and a

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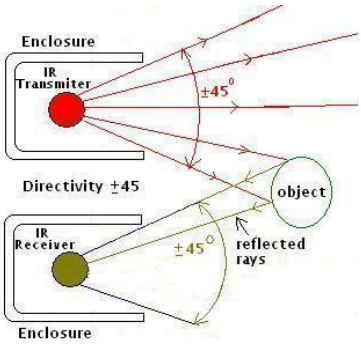
signal is received at the IR receiver when the IR radiation bounces back from a surface of the object.

Here in the figure the object can be any thing which has certain shape and size, the IR LED transmits the IR signal on to the object and the signal is reflected back from the surface of the object. The reflected signals is received by an IR receiver. The IR receiver can be a photodiode / phototransistor or a ready made module which decodes the signal.



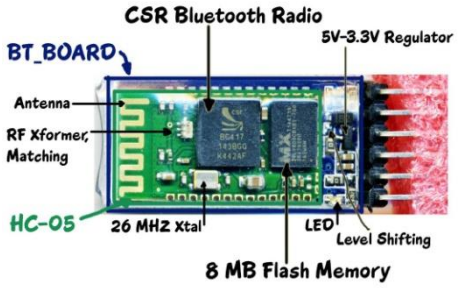
METAL DECTECTOR :

A metal detector is an electronic instrument which detects the presence of metal nearby. Metal detectors are useful for finding metal inclusions hidden within objects, or metal objects buried underground. They often consist of a handheld unit with a sensor probe which can be swept over the ground or other objects. If the sensor comes near a piece of metal this is indicated by a changing tone in earphones, or a needle moving on an indicator. Usually the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes.

Another common type are stationary "walk through" metal detectors used for security screening at access points in prisons, courthouses, and airports to detect concealed metal weapons on a person's body. The simplest form of a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternatingmagnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and this produces a magnetic field of its own. If another coil is used to measure the magnetic field (acting as a magnetometer), the change in the magnetic field due to the metallic object can be detected.

BLUETOOTH DEVICE :

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.Go shopping Serial Port Bluetooth Module



(Master/Slave):HC-05 (IM120723009)

FABRICATION OF C-SHAPED LEGS:

Cast iron is a group of iron-carbon alloys with carbon content greater than 2%. The alloy constituents affect its colour when fractured: white cast iron has carbide impurities which allow cracks to pass straight through; grey cast iron has graphite flakes which deflect a passing crack and initiate countless new cracks as the material breaks.

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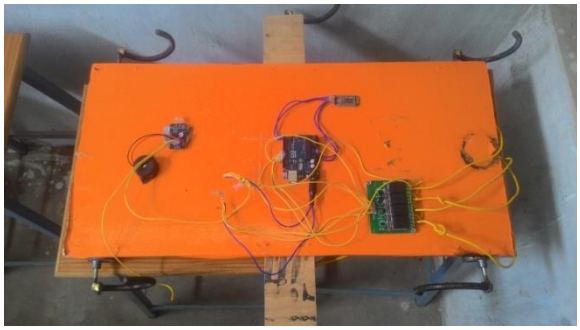
Carbon (C) and silicon (Si) are the main alloying elements, with the amount ranging from 2.1–4 wt% and 1–3 wt%, respectively. Iron alloys with less carbon content are known as steel. While this technically makes these base alloys ternary Fe–C–Si alloys, the principle of cast iron solidification is understood from the binary iron–carbon phase diagram.



V. RESULTS:

The Hexapod Robot for Metal Detecting has been successfully designed and tested. It has been developed by integrating features of all the hardware and software components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.The movement of the robot is found satisfactory when tested on plain lands as well as on granular medium. The c-shaped legs aided for the movement of the robot by taking the load equally on all the moving legs and also provided more stability to the robot. The working of navigation controls and the sensors are also tested to be satisfactory.

VI. DISCUSSION:

The main aim of this project is to aid the Indian military with the main application of detecting the mines. This project is designed with micro controller, encoder, decoder, IR transmitter and receiver, bomb detector, deriver circuits, analog with motors and robot model. Bomb detector is just act as metal detector which detected any metal in the required areas as the bombs made with metals. The bomb detector is attached in the front side of the robot. Robot movements are controlled remotely.

This remote controlled metal detecting robot can be used for detection of mines in remote and others places to know the location of the mine. Since whenever this robot passes through a mine, it detects the mine and produces a buzzer sound and thereby the location of the mine can be traced out by knowing the location of the hexapod.A new concept for developing hexapod robots using c-shaped wheels is proposed in this work. The developed hexapod robot possesses significant advantages over those with common circular wheels in traversing rocky and uneven terrain.

VII. CONCLUSION:

The Wireless Bomb Disposal Robot has been designed in such a way that it can cater to the needs of the bomb disposal squad, the military, the police and also for the personnel who handle radioactive materials. It has countless applications and can be used in different environments and scenarios. Some of the major advantages of this robot are:

- It is fast and robust.
- It can be controlled remotely.
- It is suitable for sand, rocky and granular areas
- The c-shaped legs are more suitable for rocky areas when compared to conventional circular wheels.
- Loss of humans and animals can be greatly reduced by using this robot in the bomb squad.
- Persons with less technological knowledge and less skill can easily operate this robot using a few switches of an android phone.

Cost of maintenance is less and also the spare parts are easily available.

VIII. FUTURE SCOPE:

The system that is built is a working prototype of a robot, which should be compact, fast and accurate. This prototype may not have the features and reliability of the original design. It is only being developed to ensure that the design is feasible, not impractical and can be implemented on a much larger scale in a more efficient way.

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Hence the future enhancements may include a much smaller, faster, more reliable machine. Some of these enhancements are described below:

- **Compact Design** A compact design results in a much faster motion and thus increases the accuracy and efficiency. Therefore the robot can be enhanced to be of much smaller size for the purpose of a faster and accurate operation. Compact design is also required where the situation demands the robot to reach for small places.
- **Robotic Arm/ Gripper**A robotic arm or a gripper can be used to manipulate the object, which poses a threat or is suspicion and can be moved from a critical place to a much safer place. It can be constructed to be a two-finger type gripper which can be controlled using a stepper motor that allows a firm grip on the object.
- **Vision Transmission** An analog wireless camera can be used to transmit video to a Remote Computer System, which helps in controlling the robot remotely and in object analysis or disposal. The wireless camera will have its own transmitter and receiver system, which provides a wireless link from the robot to the control application. It can be mounted on the robotic arm or anywhere on the robot to provide a live view of the remote site. The application can record the video input from this camera for further analysis. This can also be used for surveillance applications.

Artificial Intelligence At present the robot does not have the capability to make decisions on its own that is there is no built in artificial intelligence in it. Therefore the robots' working is based purely on the decisions made by the end user of the robotic control application. Therefore Artificial Intelligence may be provided to the robot for making the process of decision-making much quicker and reliable. For example a database can be merged in the application, which can be used to construct evaluation by identifying the object with the help of the camera. The camera gives input to the database that is compared with the contents of the database and if a match is found the corresponding entries of the database gives the desired actions to be performed by the robot on the object, which makes the task much easier for the end user.

IX. REFERENCES:

THE OPTIMIZATION OF LEGGED ROBOTS

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RHEX: A BIOLOGICALLY INSPIRED HEXAPOD RUNNER

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DEVELOPMENT OF HEXAPOD ROBOT WITH MANOEUVRABLE WHEEL.

Mohamed Kassim and Annisa , Jamali International Journal of Advanced Science and Technology, 49. pp. 119-136. ISSN 2005-4238 .

SENSOR DATA FUSION FOR BODY STATE ESTIMATION IN A HEXAPOD ROBOT WITH DYNAMICAL GAITS

Dept. of Electr. & Syst. Eng., Pennsylvania Univ., Philadelphia, PA, USA H. Komsuoglu ; D. E. Koditschek.

SINGLE-LEGGED HOPPING ROBOTICS RESEARCH—A REVIEW

Ajij Sayyad B. Seth and P. Seshu.

2.1 ROTATIONAL LEGGED LOCOMOTION
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A META-ANALYSIS OF FACTORS AFFECTING TRUST IN HUMAN-ROBOT INTERACTION

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- Deborah R. Billings
- Kristin E. Schaefer, University of Central Florida
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- Jessie Y. C. Chen, U.S. Army Research Laboratory
- Ewart J. de Visser
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MANAGING WORKLOAD IN HUMAN–ROBOT INTERACTION: A REVIEW OF EMPIRICAL STUDIES

- Matthew S. Prewett
- Ryan C. Johnson
- Kristin N. Saboe
- Linda R. Elliott
- Michael D. Coovert