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Micro-Controller Based Obstacle Avoiding Autonomous Robot

[1]Subhranil Som, [2]Arjun Shome
[1,2]Department of Computer Application, JIS College of Engineering, Kalyani, WB, India

Abstract
Main aim of this paperwork is to study development of the obstacle avoiding spy robot, which can be operated manually as per the operator wants to take control of the robot himself, it also can be autonomous in its actions while intelligently moving itself by detecting the obstacles in front of it by the help of the obstacle detectable circuit. The robot is in form of a vehicle mounted with a web cam, which acquires and sends video as per the robots eye view to a TV or PC via a TV tuner card. The microcontroller chip ATMEGA 328 present on the microcontroller board ARDUINO controls the movements of the robot. In manual operating conditions the user will have a radio transmitter (tx) via which the user will send signal to the radio receiver (rx) present inside the robot which accordingly will pass on the signal to the microcontroller board, and as per the coding of the signal signatures burnt inside the microcontroller chip the robot will complete its movements. In Autonomous operating conditions the user will have no control on the robot that is the robot cannot be operated via any external controls, it will only function as per the data received from the obstacle detection circuits to the microcontroller which will make the robot motors move accordingly as per the code written in it. The idea is to make a robot to tackle the hostage situations & cope up with the worst conditions, which can be quiet a matter of risk to be handled by human being.

Keywords: Obstacle avoiding, self-powered, wireless control

I. Introduction

The global focus on terrorism and security may have geared up following the 9/11 attacks in the USA. The risk of terrorist attack can perhaps never be eliminated, but sensible steps can be taken to reduce the risk. The word "Robot" was first used in a 1921 play titled R.U.R. Rossum's Universal Robots, by Czechoslovakian writer Karel Capek. Robot is a Czech word meaning "worker." Merriam-Webster defines robot [2] as "a machine that looks like a human being and perform various complex acts; a device that automatically performs complicated, often repetitive tasks; a mechanism guided by automatic controls." ISO describes a robot as "an automatically controlled reprogrammable, multipurpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications". Yet, all these definitions do give us a rough idea about what comprises a robot, which needs to sense the outside world and act accordingly. There are motors, pulleys, gears, gearbox, levers, chains, and many more mechanical systems, enabling locomotion. There are sound, light, magnetic field and other sensors that help the robot to collect information about its environment. There are Processors powered by powerful software that help the robot make sense environmental data captured and tell it what to do next and also microphones, speakers, displays, etc that help the robot interact with humans. The faithful robots do not hesitate to tread even the dreaded terrain of battlefields [3]. Their use in Afghanistan and Iraq wars make us wonder if robots have indeed become intelligent! Battle robots of various shapes and sizes were deployed to defuse landmines, search for criminals hiding in caves, search for bombs under cars and in building. Humans controlled these robots.

In this paper it has been involved with the discussion of building a prototype of an Obstacle avoiding Autonomous and manual robot, in where the main robot brain is the ATMEL ATMEGA328 microcontroller board [4, 5], which controls the total robot behavior as per the user needs by the use of a motor driver circuit for wheel movements [6, 7, 8, 9] a wireless transmitter and a receiver for the manual wireless operations by the user, the Obstacle avoiding circuit for obstacle detection and avoidance using IR LEDs. And a wireless camera attached to the robot for live transmission of the Robot's view, which will be wirelessly connected to a pc, a laptop or a TV and visualized accordingly. It can be operated with both manual and automatic modes as per the user needs.

Section II has been involved with the discussions of Hardware details of the robot section where the each and every hardware requirements and specifications are mentioned for the proposed technology. Section III comprises of Software implementation, the use of software for the logical coding to drive the hardware accordingly. Section IV Comprises of the algorithm for the proposed robot operations. Section V comprises of the applications

of the proposed robot. Future scope is discussed in Section VI. Conclusive discussions are in section VII. Section VIII is noted down the references used or studied.

II. Hardware Implementation

The block diagram of the hardware implementation of the entire system is as shown in the Figure1. This robot is radio operated, self-powered and has all the controls like a normal car. Wireless camera will send real time video and audio signals, which could be seen on a remote monitor, and action can be taken accordingly.

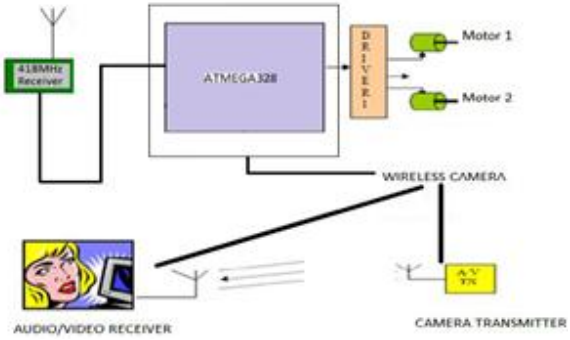


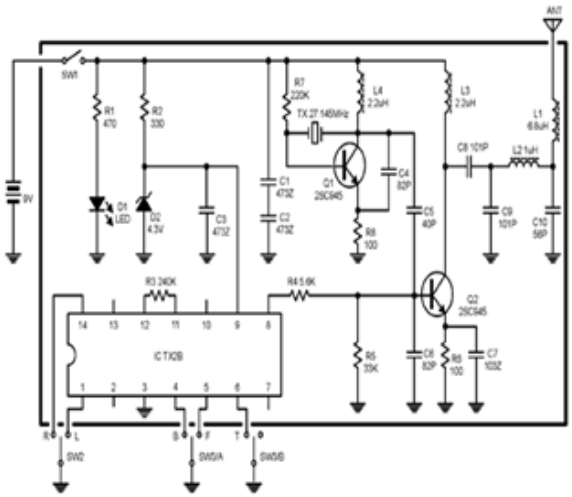
Figure: 1
HEART OF THE ROBOT IS ATMEL'S ATMEGA328 MICRO-CONTROLLER.

II.I. Manual Mode

Micro-controller acts as master controller decodes all the commands received from the transmitter and give commands to slave microcontroller. It also acts as Slave microcontroller, which is responsible for executing all the commands received from the master and also generating PWM (Pulse Width Modulation) pulses for the speed control. Based on the input codes master will give command to slave micro-controller and robot will behave as follows.

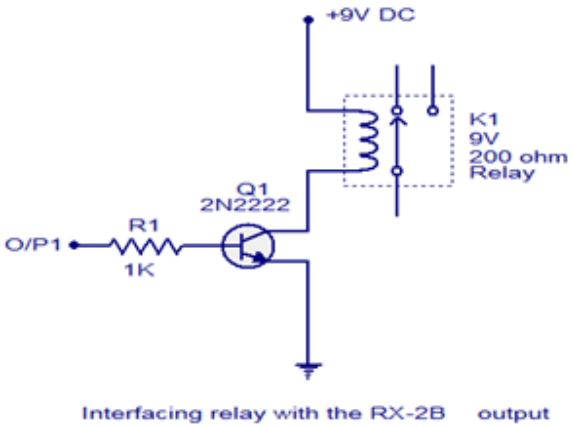
- Moves in forward direction
- Moves in reverse direction,
- Speed controls in both the direction
- It can even turn left or right while moving forward or in reverse direction.
- Instant reverse or forward running without stopping.

Transmission module Circuit (IC TX-2B) [12] is given in Figure: 2.



Transmission module Circuit (IC TX-2B)
Figure: 2

Receiver Module Circuit (RX-2B) [13] is given in Figure: 3.



Receiver Module Circuit (RX-2B)
Figure: 3

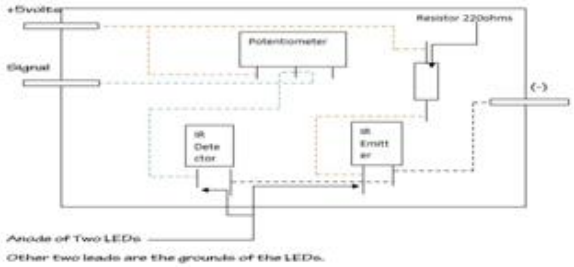
II.II. Automatic Mode

The robot will even be able to run at automatic mode, that is, it will be an autonomous body, and the performance of the robot will depend upon the microcontroller installed inside it, which will only be able to operate the robot, and it will not require any external force or help to perform its actions, which will be dependent on and as per the logical program burned in the ATMEGA328 microcontroller chip.

The robot to function automatically will require a circuit, which will provide the robot with the help of obstacle detection and avoidance of crashing to any sort of obstacles. The photo of the robot is given in the Figure: 4.

The Proposed Robot
Figure: 4

The Circuit design is provided in the Figure: 5.



Circuit Design
Figure: 5

The two IR led ground pins are connected together to make a single ground connection, because all grounds need to be connected together in a circuit.

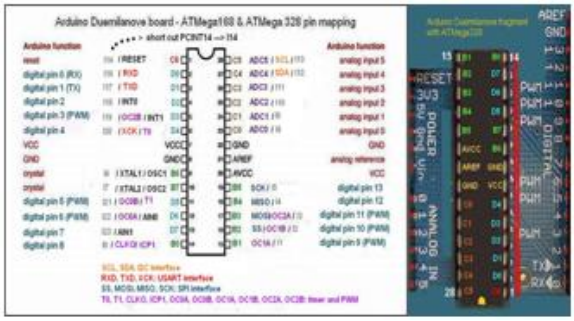
The anode of the detector is connected to the middle pin of the potentiometer, which is connected to analog input of the Arduino.

The anode of the emitter is connected to one pin of the resistor (220 OHMS), and the other pin of the resistor is connected directly to 5volts. From the left and right two pins one pin of the Potentiometer is connected to 5 volts.

II.III. Brain of Robot

The High-Performance Atmel 8-Bit AVR RISC – Based Micro-Controller Combines 32 KB ISP Flash Memory With Read-While-Write Capabilities, 1 KB EEPROM, 2 KB SRAM, 23 General Purpose I/O Lines, 32 General Purpose Working Registers, Three Flexible Timer/Counters With Compare Modes, Internal And External Interrupts, Serial Programmable USART, A Byte-Oriented 2-Wire Serial Interface, SPI Serial Port, 6-Channel 10-Bit A/D Converter (8-Channels

In TQFP And QFN/MLF Packages), Programmable Watchdog Timer With Internal Oscillator And Five Software Selectable Power Saving Modes. The Device Operates Between 1.8-5.5 Volts. By Executing Powerful Instructions In A Single Clock Cycle, The Device Achieves Throughputs Approaching 1 MIPS Per Mhz, Balancing Power Consumption And Processing Speed. Atmega328 Is Commonly Used In Many Autonomous Systems Where A Simple, Low-Powered, Low-Cost Micro-Controller Is Needed [10, 11]. That Is Why This Micro-Controller Has Been Chosen. The Pin-Out Diagram Of The ATMEGA 328 Microcontroller Is Given In The Figure: 6.



Pin-out diagram of the ATMEGA 328 Micro-controller
Figure: 6

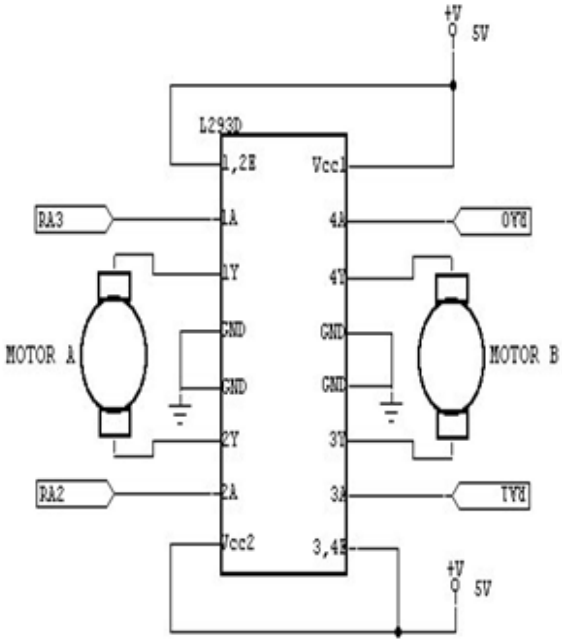
II.IV. Motor Driver Circuit

The motor circuit deals with the movement of the robot front back left or right as been programmed and enabled through the motor driver the H-BRIDGE (L293DNE). The motor circuit consists of two motors with two wheels attached to them.

The materials used to build the motor circuit are as follows:

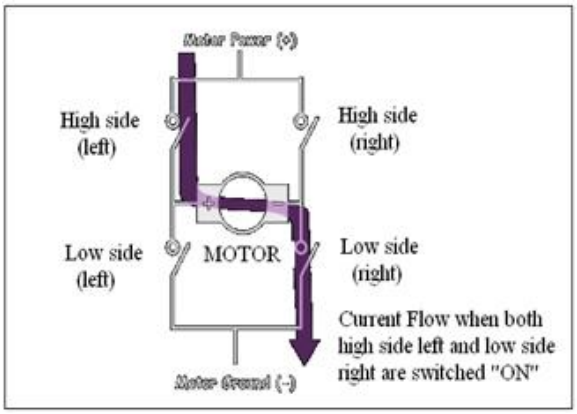
1. A H-BRIDGE IC
2. 12volt 300 RPM motors
3. Breadboard & Jumper Wires

The circuit diagram of the H-Bridge circuit is given in the Figure: 7.



H-Bridge circuit
Figure: 7

The four GND i.e. ground pins are attached together and sent to the ground of Arduino. The two VCC pins are the power pins VCC1 of 5 volts is the power for the running of motors and the VCC2 (5-12vols and above) is the power for the H-Bridge IC. The 1,2E and 3,4E are the two enable pins of 5 volts that is if these two pins are supplied with 5 volts both the motors will run, and if one is given 5 volts then the motor of that side will only be enabled to run. The RA0, RA1, RA2, RA3 are the all-digital output pins of the IC the RA0 and RA1 are for motor B and the RA2, RA3 are for motor A if one pin is set high and the other pin low then the motor will run clockwise / anticlockwise and if the opposite is done then vice versa. One motor is connected to 1Y and 2Y and the other is connected to 3Y and 4Y. Block diagram of L293D mechanism is given in Figure: 8.



Block diagram of L293D mechanism
Figure: 8

Truth Table				
High Left	**High Right**	**Low Left**	**Low Right**	**Description**
On	Off	Off	On	Motor runs clockwise
Off	On	On	Off	Motor runs anti-clockwise
On	On	Off	Off	Motor stops or decelerates
Off	Off	On	On	Motor stops or decelerates

II.V. Receiver Camera

It is mini wireless monitoring video camera and wireless receiver set for home and small business surveillance and is used here for demonstration purpose. Simply install the wireless camera in the room where we want to monitor and set the wireless receiver in the next room (up to 15 meters away) and hook it up to a TV or DVR to watch the action or record the footage for the security records.

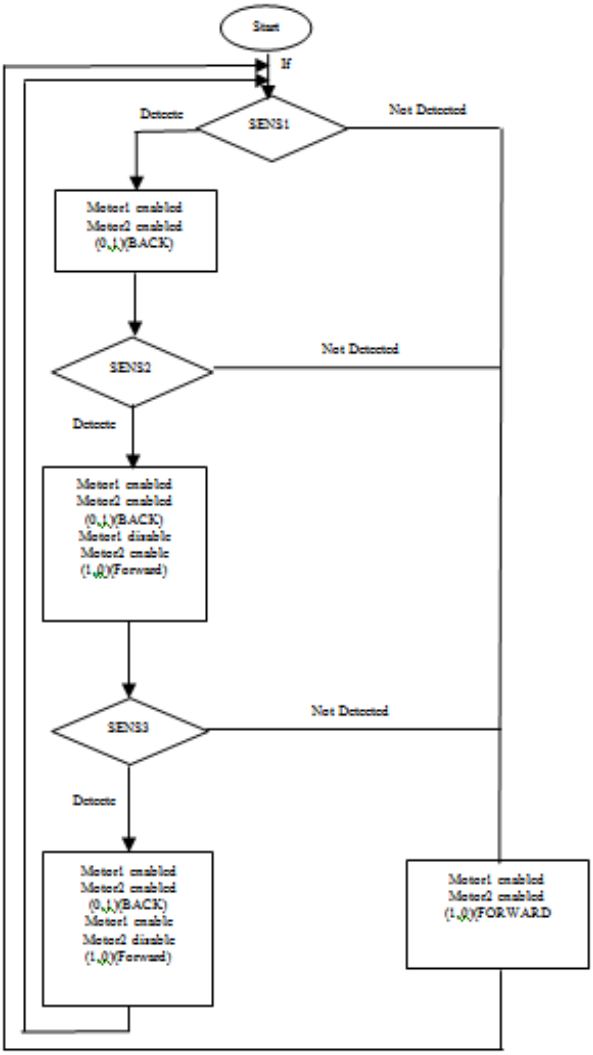
II.VI. Capture card

A TV capture card is a computer component that allows television signals to be received by a computer. It is a kind of television tuner. Most TV tuners also function as video capture cards, allowing them to record television programs onto a hard disk. The card contains a tuner and an analog-to-digital converter along with demodulation and interface logic.

III. Software Implementation

The open-source Arduino environment makes it easy to write code and upload it to the I/O board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing, avr-gcc, and other open source software. The software version used: Arduino IDE 1.0.5

The flowchart of logical working of the Robot (automatic mode) is given in Figure: 9.



Flowchart of logical working of the Robot (automatic mode) FIGURE: 9

IV. Algorithm

- **Step1:** Initialization of I/O ports.
- **Step2:** Set Direction as Forward/ Backward/ Left/ Right.
- **Step3:** checks if any obstacle is detected according to that change the motion of Robot. If no then Robot will goes in forward direction.
- **Step4:** Wait for some time.
- **Step5:** go to step 3 to repeat the process.
- **Step7:** Wait for some time.
- **Step 8:** End

V. Applications

Can be adequately implemented in national defense through military-industrial partnership.

1. Can be vastly applied in Resorts, borders of noted threatening or suspicious places for further investigations or monitoring.
2. Installation of robots in the stadiums, sacred places, a government and non-government organization assures top security.
3. In Mines at high radiation situations where its threatening for a human presence.

VI. Future Scope

We can extend this paper with installation of artillery for army field operations. This robot can be used for pick and place the required object by installing robotic arms in it. It can be mounted with radiation sensor, so that it can keep track of radiations at research laboratories, where there is a high risk of radiation risk. Implementing the technology of image processing to make various camera applications like personality checker, an alarm system whenever and wherever required.

VII. Conclusive Discussion

Remote controllers are designed to direct the orientation of robot. Robot keeps on moving in two modes i.e., Manual mode and Automatic mode. It's brought under user's control in the case of manual mode. In automatic mode, robot starts moving over surface and takes action according to the program and hardware support. To detect the obstacles, a circuit of Infrared sensors (3 pairs) has been deployed in the front portion of the module. While moving on the surface, if the left sensor is detected, robot takes back the position for a moment and moves right. If the right sensor is detected, robot gets back and moves left. As known, these days India is sick off massive terror attacks, bomb explosions at plush resorts. To avoid such disasters TECHNOLOGICAL power must exceed HUMAN power. Human life and time are priceless. Even every nation needs its own defense system for their integrity and security. In such a way construction of these robots will carry nation's name, fame globally. The basic idea of the paper was to develop a robotic system which would run by itself without any external help as well as user controlled during emergencies and detect obstacles in front of it at short range, after the obstacle will be detected it will make a beep alarm and stop itself and move to the direction which is free from obstacles within the range of detection. The Robot would run best and more efficient at ZERO INFRARED INTERCEPTIONS, that is, where no infrared light is present other than the light from the Infrared emitter of the Robot's sensor circuit.

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Dr. Subhranil Som received his Master degree in Computer Application in 2003. His PhD in Computer Science and Engineering Technology from University of Kalyani, West Bengal, India in the year of 2012. He is an empanelled PhD supervisor in

the area of technology in the West Bengal University of Technology. He is working as a Principal Investigator of an UGC funded project. He holds a distinction in Physics and Mathematics in Graduation. His fields of interest include Cryptography and Network Security, Robotics, Core Java, C++, C. He is currently Asst. Professor in the Department of Computer Application, JIS College of Engineering, West Bengal, India. He was attached with a WHO's International Research Project on "e-Health for Health Care Delivery", University of New South Wales, Sydney, Australia. He has finished several courses related to computer Application, object oriented analysis and design, Software Engineering and Project Management. He has more than 8 years teaching and research experience.

Mr. Arjun Shome pursuing Graduation degree in Computer Application 2011-2014 in JIS College Of Engineering under the West Bengal University Of Technology. He has participated in several Exhibitions.