Robot Car for Exploring Dangerous environments controlled by Bluetooth

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Abstract: *Car controlling one of the projects that get a lot of attention in this days. There are many challenges generated during implementation of system especially when the car connected with number of sensors and that mean there are send and receive between the car and the work station. In this work we will design a vehicle able to detect the dangerous environments that humans cannot reach it. This means that we can send commands to control the car and receiving data from the sensors. The robot car will measure the temperature and the amount of toxic gases and detect motions. Also it has a camera for online video transmitter to monitoring the environment and helping control the robot car from the work station.*
Keywords: *Robot, Sensors, Arduino, Bluetooth*

I. Introduction

A robot is a devise created to perform a special tasks. It can be control directly by the human or using predefined program usingartificial intelligence techniques. The first commercial robot was developed in 1961 by Ford company andused incars factories. The robots were principally intended to replace humansin monotonous, heavy and hazardous processes. Nowadays, stimulated by economic reasons,industrial robots are intensively used in a very wide variety of applications[1][2]. One of the most common technique used for communication is Bluetooth. Bluetooth exchange data between two device and allow to control and monitor the robots. The first use of Bluetooth was by "Ericsson" in 1994. The main aim for Bluetooth was integrating with smart device such as phones. Through the years, the number of phone users increased made Bluetooth the main portable communication device for data exchanging and made wireless communication more popular. Also, Bluetoothhas the capability of efficient communication withmany Bluetooth models rich to seven models simultaneously through one link. [3]

We've built this research work to provide a robot car that able to discover dangerous environment before exploring it by human. An example of these dangerous environments is the fire in a certain building, after extinguishing the fire we need to know the temperature and the amount of toxic gases emitted so we send this robot to get the readings before sending a human. Another example is the narrow place where because of the size of the robot we can send it to the narrow places and get the full readings in addition to the online video of the camera in the front of the robot.

This work organized in to the following five sections:Section 2 describes the components which used to build the robot car, Section 3 describes the assemblage and installation of the robot, Section 4 describes the interface of robot controlling, Section 5 is theresult and the data which gathered by the robot sensors, section 6is the conclusion and future work possibilities.

II. Robot Car Components

In this part all the components that used in robot car will explain in details. The general features explained and the general structure of each component was explained. So the aim of this chapter is to introducing all used components details and usage without mention the way of assembling.

A. Robot car Chassis

we select a 4-wheels with 15x25 cm robot chassis. The 4 wheels give the robot flexibility to move in all direction. The size of chassis give the robot flexibility to move in narrow areas that are hard for the human to reach. The robot frame showed in Fig. 1. It contain two layers with 4 wheels and a dc motor for each wheel. This type of frame has a lot of advantages to use. One of them the suitable size which can go through many narrow areas. Also, the two layer gives is the ability to position all the components in appropriate places.
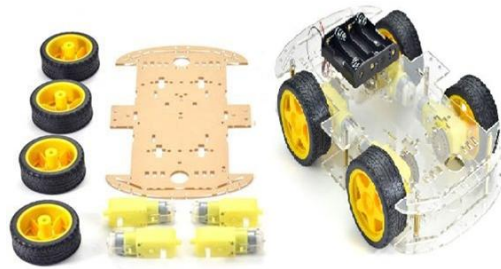

Fig. 1 *Robot Car Chassis [4].*

B. **L298n motor driver**

The l298n driver allow the controller to control the speed and direction of two DC motors in each side with ease. It can be used with motors that have a voltage between 5 and 35V DC. The l298n designed to accept standard TTL (Transistor-transistor logic: is a class of integrated circuits which maintain logic states and achieve switching with the help of bipolar transistors. Fig 2 showing the l298n.
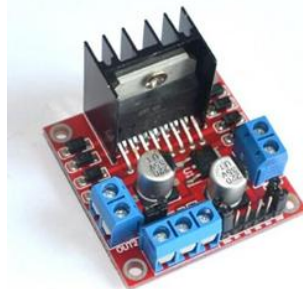

Figure 3.2 *the L298n Motor Driver [4].*

C. **Arduino**

One of the most popular microcontroller boards in this days is an Arduino. it can be powered by battery or using AC to DC adapter.it is based on the AT mega 328. ATmega328 is a microcontroller chip with capacity of thirty two kilo bit instruction per second flash memory. It has 23 General purpose input-output lines and operater between 1.8-5.5V. There are two different types of input in the Arduino. in general it has 14 pins with digitil signal. The rest 6 pins with analoge signal. Arduino microcontrollers can be programmed with a boot loader that simplify the process of uploading programs to the on-chip flash memory. Fig. 3 showing the Arduino Uno which used it in our robot car.

Fig. 3 *Arduino Uno [4].*

D. **Sensors**

A sensor is a device with different sizes some big and some very small. It is detect and respond to some type of input from the physical environment. The input of sensors could be light, heat, motion, liquid, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for

reading or further processing. In our robot car we used three sensors to get the required information about the environment. This sensors are:
- Temperature sensor.
- Motion sensor.
- Gas sensor.

E. **Bluetooth HC-05**

HC-05 is a MASTER / SLAVE module using for transmitting the data between the PC and the Arduino. In our robot car the Bluetooth send the sensors data to the pc and receive the movement instructions from it. Fig. 4 showing the HC-05 Bluetooth model.
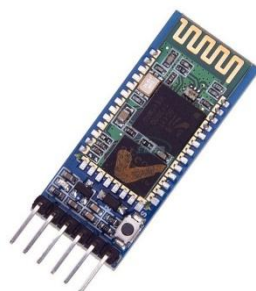

Fig. 4 *HC-05 Bluetooth Model [4].*

F. **Eken h9 Camera**

Eken h9 is an action camera with many features made it suitable for our robot car. The main important feature is the Wi-Fi connection. Also it has many other features such as 170o wide angle lens, 12mega pixels CMOS-sensor … etc. Fig 5 showing the eken h9 camera.

Fig. 5 Eken action camera [5].

The mean advantage of using eken is the Wi-Fi connection. We can control the robot car using Bluetooth and receiving the camera signal by the Wi-Fi at the same laptop.

III. Assemblage and Installation

First we connect the power supply to the l298n motor driver. We used li-po battery with 11.1 volt and 1300 mAh capacity. Motor drive will receive 11.1 volt and supply the Arduino with 5 volt. Motor drive receiver control signals from the Arduino. For each side of the motors there are a set of pins in the motor drive. The signals go through this pins from the controller to the motors.

In next step, we powered the Arduino with 5 volt coming from the motor drive. When Arduino powered we can supply all three sensors and the Bluetooth from it. The pins of Arduino connected in this form:
1. Pin 0 (RX) to the TX pin in the Bluetooth.
2. Pin 1 (TX) to the RX pin in the Bluetooth.
3. Pins 4,5,6 and 7 control the DC motors.
4. Analog pin 0 receiving signal from gas sensor.
5. Analog pin 1 receiving signal from Temperature sensor.
6. Analog pin 2 receiving signal from motion sensor.
7. 5 volt pins and GND pins powered the sensors and the Bluetooth directly.

In this way our 1,4,5,6 and 7 pins are sending data to Bluetooth and DC motorrespectively. The 0, A0, A1 and A2 pins are receiving data from the Bluetooth and sensors respectively.

The camera will use own power source and this is another advantage in which we will have two separate power source. The work time before needing to recharge will be long.

IV. Programing Languages Used

G. Arduino Software

The Arduino Development Environment has a number of built in features. This features directly accessed by the Arduino Development Environment drop down toolbar. The toolbar provides a wide variety of features to compose, compile, load and execute a sketch. Aside from the toolbar accessible features, the Arduino Development Environment contains a number of built-in functions that allow the user to quickly construct a sketch. The interface of Arduino Development Environment (ADE) contains a text editor, a message area for displaying status, a text console, a tool bar of common functions, and an extensive meaning system [6].

We developed our code using ADE to achieve all the explained tasks such as data reading from the sensors and sending it using Bluetooth. Also, it is response to receive and understanding the incoming signals to control the robot car. This software which developed by the ADE uploaded to the microcontroller and its response to reading the data from the sensors and sending it using the Bluetooth. Also, it is responding to receive the incoming signals to control the robot car.

H. Processing Programing Language

This programming language depending on text programming. This language designed to modify and generate images. Also, it is easy to use where the beginner can write own program with little information about programming languages. It is also allow the user to write own libraries and create additional function. It is provide interaction techniques including mouse and keyboard. And provide network communication libraries such as Bluetooth libraries [7].

We used it to build interface to control and receive data from the robot car. The next paragraph will explain the interface of our robot car.

V. Interface and Robot Controlling

To control the robot car, we used processing which a flexible software is using for build application with interface. Our application contain one window. This window contain number of arrows which is a control instructions for each direction. We have basic 4 directions (forward, backward, left and right) and also we have extra direction which is between the basic 4 direction which are forward-lift, forward-right, backward-left and backward-right. In this way we can control our car with all possible directions. Fig. 6 showing the interface and with the directions of control and the sensors reads.
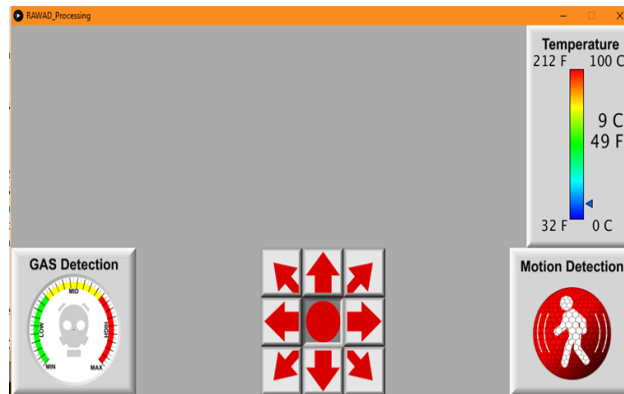

***Fig. 6** Control Interface*

The temperature is showing in the top right with two measure units Celsius and Fahrenheit. The gas image appeared in the left bottom of the interface when the sensor noticed a toxics gas in the environment.

The motion sensor,in the right bottom side, showing motion signal if there is a motion. Fig. 7 showing motion sensor detection in two state first gray which mean no motion detected. Second red which mean motion detected.
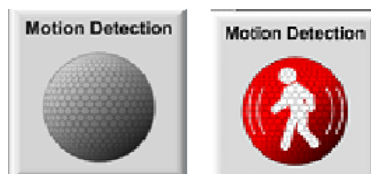

***Fig. 7** Motion Sensor Output*

For receiving the camera signal, we used VLC player. VLC player give the ability to showing online video signal with the eken h9 action camera at the same laptop. Also we can use the application of the camera which can be install in android system devices such as tablet or smart phones. In this case we will control the robot from the laptop and watching the video from another device.

Fig. 8 showing the final Form of our robot car with all components such as the Arduino, sensors, battery and the action camera which placed in the front of the car.
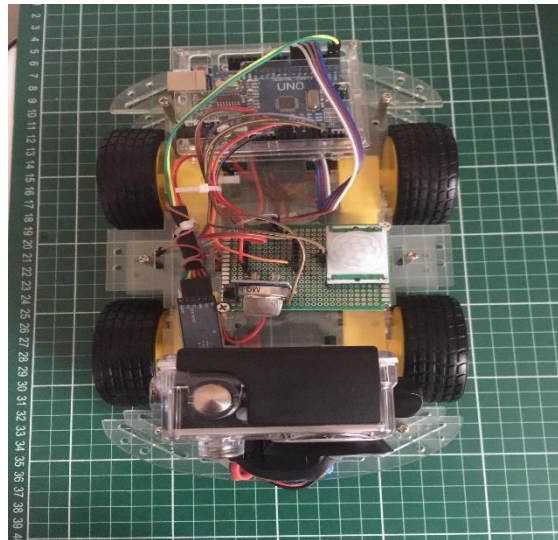

Fig. 8 *Final Form of the Robot Car*

VI. Results

Table 1 showing the data which collected from three sensors.

TABLE I.   RESULT

Sensors			Detection
Gas	*Motion*	*Temperature*	
4.48	895	10.06	*Gas and Motion Detected*
4.49	885	11.4	*Gas and Motion Detected*
4.5	890	10.55	*Gas and Motion Detected*
4.5	886	14.94	*Gas and Motion Detected*
4.5	887	15.43	*Gas and Motion Detected*
0.0	886	16.41	*Only Motion Detected*
0.0	884	16.89	*Only Motion Detected*
0.0	889	16.41	*Only Motion Detected*
0.0	889	16.40	*Only Motion Detected*
0.0	889	14.94	*Only Motion Detected*
4.01	886	15.43	*Gas and Motion Detected*
4.01	884	15.92	*Gas and Motion Detected*
4.01	885	14.94	*Gas and Motion Detected*
4.41	886	15.92	*Gas and Motion Detected*
4.43	891	15.92	*Gas and Motion Detected*
4.43	891	14.96	*Gas and Motion Detected*

In table 1, the data are coming directly from the sensors. The controlling of the data threshold and converting from voltage to understandable numeric values occur in the Arduino. For example the temperature sensor will send analog signal to the Arduino. The Arduino will convert it to voltage using this equation:

$$Voltage = reading\ signal * (5.0/1024) \qquad (1)$$

Then, to convert it into temperature, we will use this equation:

$$Temperature = (voltage - 0.5) * 100 \qquad (2)$$

And in this way the code will convert the incoming signal from the sensor to understandable information.
For the gas sensor the threshold set by the Arduino equal 4. If the value pass this threshold then the system will showing gas detected. The threshold of the motion sensor equal to 400.

VII.   Conclusion and Future Works

This work describes a robot car for exploring the dangerous area using Arduino and some sensors based on wireless Bluetooth communication. Also the robot Provide with camera that transmit video directly using Wi-Fi. The advantage of our work is that it easy to control and easy to understanding the incoming data because we built an interface to monitor environment variables. As a result, our robot can work directly and measuring the temperature, Toxic gas and any detected motion with real time video from any environment need to explore.

For the future work we advise to use long range communication method to increase the range of distance for controlling the robot car. Also we advise to add another sensors to get more reading about the environment variables.

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