MULTIFUNCTIONAL ROBOT USING ZIGBEE

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ABSTRACT: These days robots with wireless communication are being rapidly spread and implemented in different fields. The applications extend to home automation, industrial automation, defense and medical fields too. This paper presents multifunctioning robot which uses Zigbee as a communication between PC and robot with gas detector, IR flame sensor whose outputs (status) are displayed on lcd display as well as monitor. Wireless camera which gives continuous monitoring advantage when implemented along laser gun can be used for defense purpose.
Keywords- Robot, microcontroller, sensors

I. INTRODUCTION

For quite some time using robots in various field has become very popular. The advantage of using robot in military application is that it can perform dangerous tasks without any danger to human life. There have been systems used for security purpose with varying applications which use PIC microcontroller[1], ARM7[2], 89S52 microcontroller[4]. The present system can be used to detect gas, fire, monitor surroundings using wireless camera using Zigbee which will help the communication between PC and Robot. This system also has a laser gun attached so that the captor can be neutralized without having a soldier to risk life.

The main aim of the project is to implement a multipurpose Robot which can be controlled in a wireless manner through PC using Zigbee interface used for defense purpose. It has built in gas sensor for gas leak identification, an IR flame detector which is used for fire detection. This multipurpose robot that activates different functionalities in the robot unit based on the signal received from the microcontroller. The outcome of different activities can be monitored and displayed on LCD screen and desktop. Another factor about this robot is the wireless video camera along with laser pointer gun that can be effectively utilized to pin point the captor's location and neutralize them.
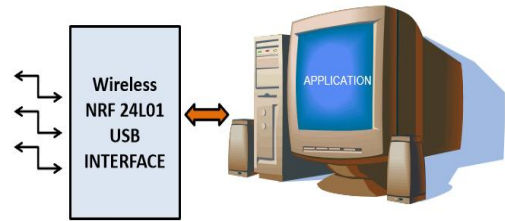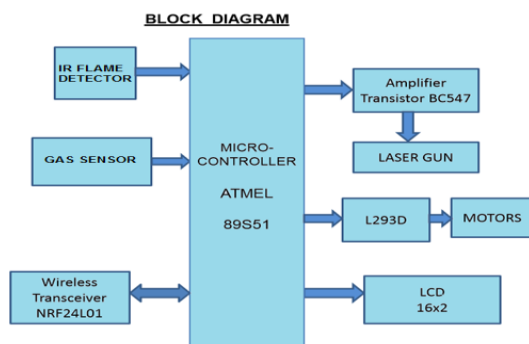
II. SYSTEM BLOCK DIAGRAM AND DESCRIPTION

Fig.1 System Block Diagram

A. MICROCONTROLLER

The 89S51 is a low-power, high-performance CMOS 8-bit microcontroller with 4K bytes of In-System Programmable Flash memory. The device is compatible with the industry-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with In-System Programmable Flash on a monolithic chip, the 89S51 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications[5].
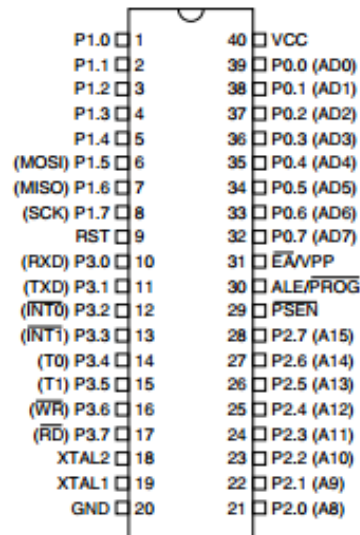

Fig.2 89S51 Microcontroller[5]

B. ZIGBEE

Zigbee is a low-cost, low-power, wireless protocol defined in IEEE standard 802.15.4 (2003 version) for low-rate WPANs. It is highly secure, reliable and easy to install[2]. Zigbee networks are secured by 128 bit symmetric encryption keys. In home automation applications, transmission distances range from 10 to 100 meters line-of-sight, depending on power output and environmental characteristics. It consists of NRF 24L01 UART MODULE / NRF 24L01 USB

MODULE which is a wireless transceiver module which provides easy to use RF communication at 2.4 GHz.
This plug and play device can be used to communicate between the following
• MCU ←→ MCU (uart – uart)
• PC ←→ MCU (usb – uart)
• PC ←→ PC (usb – usb)
It can be used to transmit and receive data at 9600/4800 baud rate from any standard CMOS / TTL / USB source. It works in half duplex mode. Channeling allows the user to use multiple modules communicating in the same RF range. Module allows host ends to communicate using two different baud rates(9600/4800).

C. GAS SENSOR
The gas sensor used has high sensitivity to LPG, Iso-butane, Propane, small sensitivity to alcohol, smoke. It has fast response, stable and long life and simple drive circuit[7]. Sensitive material of MQ-6 gas sensor is SnO2, which with lower conductivity in clean air. MQ-6 gas sensor suitable for sensing presence of LPG concentrations in the air. The MQ-6 can detect gas concentrations from 200 to 10000ppm. MQ6 gas sensor is a 6 pin device and it requires 5 volt DC maximum.
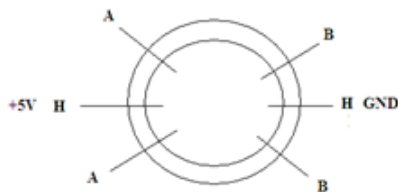

Fig.3 Gas sensor (MQ6)

D. IR FLAME DETECTOR
A flame detector uses radiation property of a fire in IR region of electromagnetic spectrum without getting affected by ambient light. A flame detector is a sensor designed to detect and respond to a flame or fire. These detectors comprise an electronic circuit with an electromagnetic radiation receiver. Flame detectors are actuated when they receive electromagnetic radiation from one or more defined wavelengths are received according to their design in the ultra-violet or infrared spectrum. Fire sensor is actually an NPN photo transistor that converts infra red radiation from any hot object into electrical energy. When light of the proper wavelength hits a semiconductor material such as a PN or NP junction, it increases the concentration of charge carriers. Small base current is created by infrared radiation coming from fire. The current output of the sensor is directly proportional to the strength of infra red radiation from the hot object (fire). The response from the detector can vary according to its installation. This sensor is used specially to detect explosions in coal mines.

E. LCD DISPLAY
A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. It is alphanumeric , i.e., it can display only numbers or letters, it cannot display pictures. Its operating voltage is 5 volt.
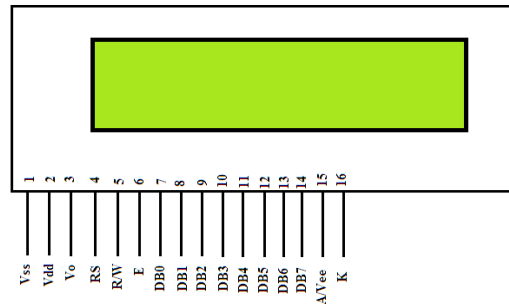

Fig.4 LCD Display

Table.1- LCD Display pin description

Pin No.	Symbol	Description
1	Vss	Supply Voltage for logic Ground
2	Vdd	Supply Voltage for logic and LED backlight
3	Vo	Operating voltage for LCD
4	RS	H:DATA, L: Instruction code
5	R/W	H: Read(MPU→Module); L: Write(MPU→Module)
6	E	Chip enable signal
7	DB0	Data Bit 0
8	DB1	Data Bit 1
9	DB2	Data Bit 2
10	DB3	Data Bit 3
11	DB4	Data Bit 4
12	DB5	Data Bit 5
13	DB6	Data Bit 6
14	DB7	Data Bit 7
15	A/Vee	Power supply for backlight V+/Negative Voltage Output
16	K	Power supply for backlight V-

F. L293D
The L293 and L293D are quadruple high-current half-H drivers. These devices are designed to drive a wide array of inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current and high-voltage loads. All inputs are TTL compatible and tolerant up to 7 V. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4 EN.

When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the L293D, these diodes are integrated to reduce system complexity and overall system size. A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power dissipation. The L293D are characterized for operation from 0°C to 70°C.[8]
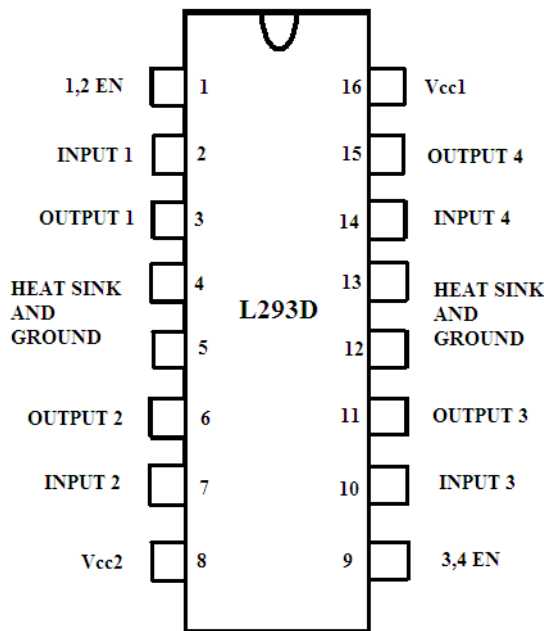

Fig.5 L293D Motor Driver[8]

G. ZIGBEE
ZigBee is the most popular industry wireless mesh networking standard for connecting sensors, instrumentation and control systems. ZigBee, a specification for communication in a wireless personal area network(WPAN), has been called the "Internet of things." Theoretically, your ZigBee-enabled coffee maker can communicate with your ZigBee-enabled toaster. ZigBee is an open, global, packet-based protocol designed to provide an easy-to-use architecture for secure, reliable, low power wireless networks. ZigBee and IEEE 802.15.4 are low data rate wireless networking standards that can eliminate the costly and damage prone wiring in industrial control applications. Flow or process control equipment can be place anywhere and still communicate with the rest of the system. It can also be moved, since the network doesn't care about the physical location of a sensor, pump or valve. The ZigBee RF4CE standard enhances the IEEE 802.15.4 standard by providing a simple networking layer and standard application profiles that can be used to create interoperable multi-vendor consumer electronic solutions. The benefits of this technology go far beyond, ZigBee applications include:

_ Home and office automation
_ Industrial automation
_ Medical monitoring
_ Low-power sensors
_ HVAC control
_ Plus many other control and monitoring uses

ZigBee targets the application domain of low power, low duty cycle and low data rate requirement devices. ZigBee basically uses digital radios to allow devices to communicate with one another. A typical ZigBee network consists ofseveral types of devices. A network coordinator is a device that sets up the network, is aware of all the nodes within its network, and manages both the information about each node as well as the information that is being transmitted/received within the network. Every ZigBee network must contain a network coordinator. Other Full Function Devices (FFD's) may be found in the network, and these devices support all of the 802.15.4 functions. They can serve as network coordinators, network routers, oras devices that interact with the physical world. The final device found in these networks is the Reduced Function Device (RFD), which usually only serve as devices that interact with the physical world. As mentioned above several topologies are supported by ZigBee, including star, mesh, and cluster tree. star topology is most useful when several end devices are located close together so that they can communicate with a single router node. That node can then be a part of a larger mesh network that ultimately communicates with the network coordinator. Mesh networking allows for redundancy in node links, so that if one node goes down, devices can find an alternative path to communicate with one another. [10]

In this paper Zigbee is used for communication between the pc and the robot. Zigbee can communicate upto 100m(line of sight). Since robot has sensors whose outputs need to be displayed on monitor, it requires low data rate. Zigbee is used for controlling the robot from PC and also to display the output of sensors on the monitor.

Zigbee can be compared to other devices using the following table; it has advantages and disadvantages over other devices.

Table.2- Comparison of different technologies[8,9,10]

Parameter	Zigbee	Bluetooth	Wi-Fi
Frequency Bands	2.4GHz	2.4GHz	2.4GHz
Range	Upto 100m	10m	Upto 100m
Transmission speed	250kbps	1Mbps	Upto 54Mbps
Complexity	Simple	Complicated	Very complicated
Max. no. of nodes	65535	8	32

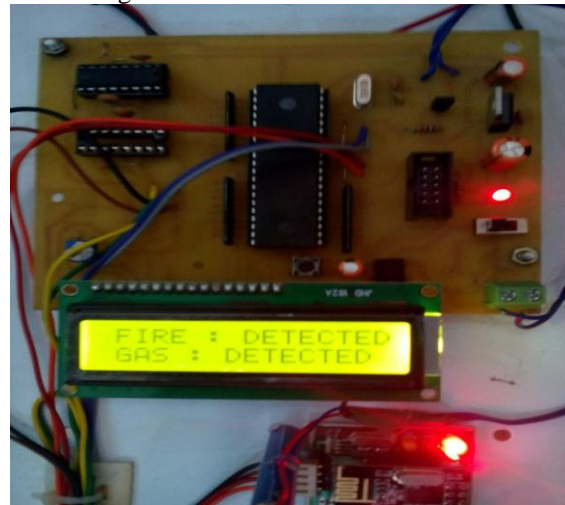| Interference avoidance method	DSSS	FHSS	DSSS
Power Consumption	Very low	Medium	High
Applications	Remote control battery operated products	Wireless USB, hadset, headset	Internet browsing, pc networking

III. RESULTS

When fire is detected

When gas is detected

When fire and gas are detected

IV. ADVANTAGES

- Consistency of performance.
- 24/7 continuous working.
- Improved quality of product.
- It can move from one location to another location.
- Robotic workers never get tired.
- Do not need to be paid.
- Can be made to perform even the most dangerous tasks without concern.
- Wide acceptance

V. FUTURE SCOPE

- Robotic arm can be placed for pick and place.
- In the robot water tank can be placed so as be used as fire extinguisher.
- Normal camera can be replaced with night vision camera.
- Zigbee technology can be replaced with other technology operate robot from long distance.
- RF sensor can be placed so that it does not collide the obstacles when not controlled manually.

VI. APPLICATIONS

- It can be used to monitor any suspicious object where presence of human may be dangerous.
- It can be used in mining due to presence of gas detector and fire detector.
- It is used in gas industries to detect leaks which can be hazardous.
- It can be used in military; dangerous tasks can be carried out by the robot without worrying about loss of human life.

VII. CONCLUSION

This paper "Multi-Functioning Robot using ZigBee" has been designed for replacement of human in many risky jobs. Now-a-days robots have a wide scope in many military and home application. In this project the movement of robot is

controlled with real time monitoring system by a wireless camera. The Microcontroller 89S51 used is low cost and can be reprogrammed. ZigBee technology is used to control the robot at a range of 100 m. Other application of this robot is it can be used in coal mines and forest because of the gas sensors and IR flame detector.

The laser gun in robot can make this robot be used for military purpose. it can cover range up to 300m. A laser gun is very accurate in pointing to the target. The overall project has a secured data transmission, easy installation and low cost.

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