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WEB BASED EMBEDDED ROBOT FOR SAFETY AND SECURITY APPLICATIONS USING ZIGBEE

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Abstract

This project proposed an embedded system for safety and security purpose robot using zigbee communication and web server. The robot has sensors for detecting Gas leakage and intruder detection. MQ6 Gas sensor detects the presence of bio hazardous gases like LPG, iso-butane, propane, LNG and alcohol, and the PIR sensor detects only the living organism (Intruder). The sensor details are first sent to the microcontroller which resides at the robotic side and then sent to the local system through Zigbee. The system also provides an audio and visual alarm to alert about the critical situation for the safety and security purpose. This robot also has a battery powered wireless AV camera which provides robotic in front environment information to the Local and remote system and performs the audio and video streaming through web server. The robotic movement is controlled remotely from the local system by using the front end application VB 6.0. The Zigbee (IEEE 802.15.4) supports a frequency range of 2.4GHZ, 9600 baud rate with 256Kb of flash memory. It supports the range of 400m in open-air, line-of-sight, outdoor environment. This proposed system is used wherever people cannot go or where things doing too dangerous for humans to do safely. That is the robot can move and reach to the high destiny gas leakage region.

Key words: Audio-Video streaming, Intruder, Remote system, Robot, PIR Sensor, Web Server, Zigbee.

1. INTRODUCTION

Mini robot is an autonomous security robot. The robot's design specifications may vary according to the given application. An embedded system is designed to perform specific control functions within a larger system, often with temporal constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems contain processing cores such microprocessors, microcontrollers and discrete processors. The key characteristic, however, is being dedicated to handle a particular task. Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase their reliability and performance [1].

1.1 Proposed system

The proposed robot is easy to design and implement both in hardware and software aspects. It uses low cost microcontroller, high sensitivity gas and PIR sensors, wireless AV camera and zigbee to support reliable and robust wireless communication network. But in existing system they have used high cost IP camera. The AT89C51 microcontroller is embedded with embedded C program which processes the received sensor data and provides safety and security alarm through zigbee communication. The mobile robot is a battery powered and controlled remotely through zigbee. At the local system, the front end is designed using VB6 which is simple coding and easy to understand. The existing system does not support live AV streaming but our system provides live AV streaming to the remote web server through tin cam. The robot integrates both safety and security functions and is useful in variety of applications like industries, resorts, government and non government organizations. This intelligent robot is mainly useful in rescue operations, which detects the alive human in disaster situations and in war fields, and also used in intelligent security purposes.

2. ROBOTIC SYSTEM DESIGN PROCESS

Figure 1 shows the embedded system design process and has five major levels of abstraction. At each and every level there are three tasks like analyze, refine and verify were performed to ensure the system requirements and specifications. There are two ways in the design methodology and are Top-down and Bottom-up method [1, 13] and this work adopts the Top-down method.

2.1 Requirements

An informal description from the customers was gathered and is known as requirements then the requirements are refined into a specification that contains enough information to begin the system architecture. Requirements may be functional or nonfunctional. We must of course capture the basic functions of the embedded system, but functional description is often not sufficient. Typical nonfunctional requirements include: performance, cost, power and physical size and weight and these requirements are given in the requirement form shown in the Table 1.

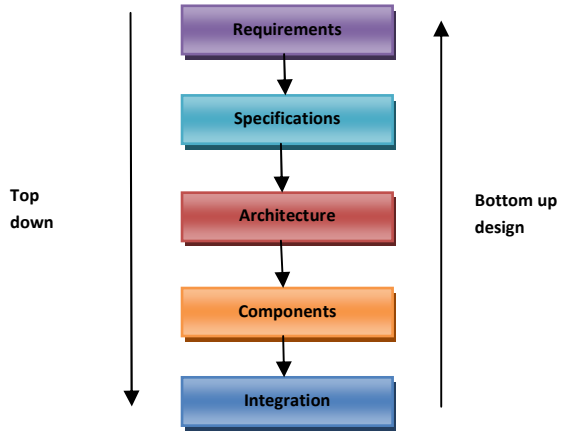


Figure 1: Major levels of abstraction in the design process

Functional Requirements:

- Sensoring requirements like the Gas, Human Detection and Audio-Video Streams.
- Alarm Monitoring requirements [If GAS, Human are detected].

- Signal conditioning requirements.
- Movement through Relay for directions that switches ON/OFF.

Table 1: Requirement form

Requirements	Descriptions
Name	Embedded Robot for Safety and security applications using Zigbee.
Purpose	ROBOT monitors the environment; provide Audio- video streaming at remote system. Raises alarm during critical situations for the safety and security purpose.
Inputs	LPG Gas Sensor, PIR Sensor, Audio and video signal.
Outputs	Remote PC display, Relays, LEDs
Functions	Depending on the Gas and PIR sensor provide alert message to local system and switch ON/OFF the relays for Robotic wheel movement. Perform Audio-Video streaming both at local and remote system.
Performance	Updates sensor data to the local system at every 5 to 8 seconds and update AV information to the local and remote system at every 0.5seconds.
Manufacturing Cost	Approx. 125USD
Power	12v, 9Amps
Physical size and Weight	11″X6.5″ and 1.700kgs

2.2 Specification

The Specification says only what the system does and does not specify how to implement. In this proposed work the specification of the system includes,

- Data received from Zigbee (100M)
- User interface
- Sensor data to the Microcontroller
- PC Display
- Alarm Monitoring
- Audio and Video from wireless AV camera

2.3 Architecture

The Architecture describes how the system implements the functions which are specified in the specification level. The system architecture is further refined in to Hardware and software architecture which describes the components we need to build the entire system. Architectural descriptions must be designed to satisfy both functional and non-functional requirements. Figure 2 shows the hardware module in which the sensors send the signals to the local system through Zigbee, the local system process the data and send the control signals to the Robot and switches the relay according to the conditions for ON or OFF the Motors [2]. The Zigbee connected to the microcontroller which sends the data from the ROBOT to the local system and the Zigbee at the local system receives the data and displays the output. Fig 3 shows software architecture of the robot.

2.4 Components

The Components in general include both designing the hardware and software components. Some of the components will be ready made, for example CPU, memory and I/O. First we have to decide that either to buy the components which are readymade or to build by ourselves. If we buy the components then the design time will be reduced and also increases the implementation speed. The components used in this work are discussed in section 3.The basic components involved in this project are,

- Zigbee
- Micro controller
- PIR Sensor
- LPG Gas Sensor
- Relays
- Wireless AV Camera
- DC Motors

2.5 Integration

The System Integration is not simply plugging everything together but also finding the bug at this stage. While testing the system, it is difficult to find why things are not working properly and hence it is hard to find and fix the bug. Due to limited facility at the target system, we have to go to host system each and every time for testing. As for as the embedded system concern the system integration is a challenging task.

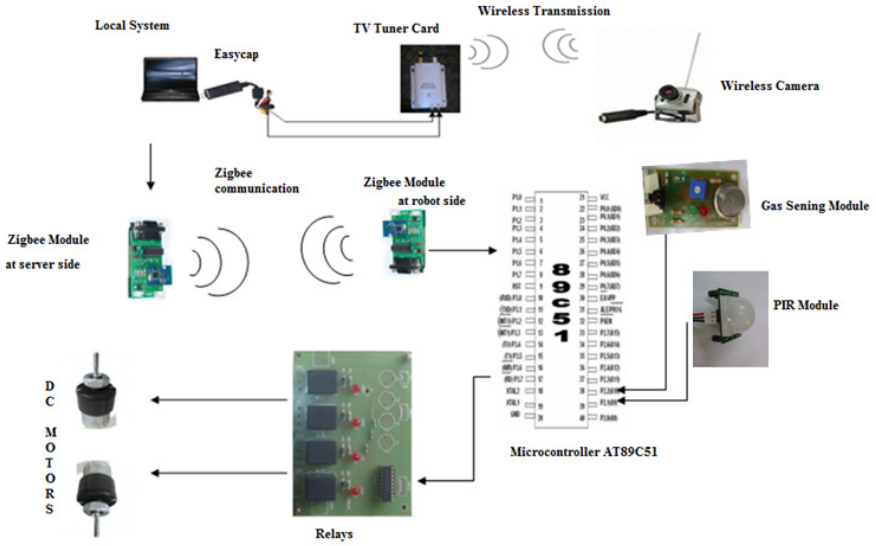


Figure 2: Hardware Architecture

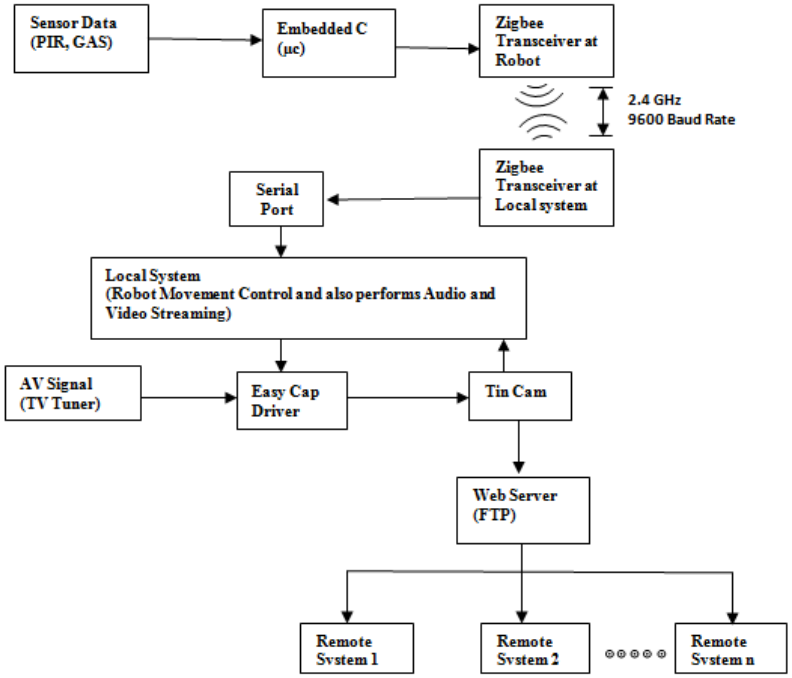


Figure 3: Software Architecture

3. HARDWARE DESCRIPTIONS

3.1. Microcontroller

AT89C51 microcontroller is used in this work which is an 8-bit microcontroller and has 4KB of Flash memory and 128 bytes of RAM. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. The Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. AT89C51 has four ports designated as P_1, P_2, P_3 and P_0 and all these ports are 8-bit bi-directional ports; they can be used as both input and output ports. Whenever the port P0 and P2 connected to an external memory they provide both low byte and high byte addresses, respectively. Port 3 has multiplexed pins which can be used for serial communication functions, hardware interrupts, timer inputs and read/write operation from external memory. It has a total of six interrupts. In this proposed system the PIR sensor module is connected with the port $P_{0.1}$/AD0 at pin number 39, Gas sensor module is with port $P_{0.1}$/AD1 at pin number 38, zigbee module's transmitter and receiver is connected with port $P_{3.0}$/RXD at pin number10 and $P_{3.1}$/TXD at pin 11 and relay driver ULN2003A is connected with the ports $P_{1.4}$, $P_{1.5}$, $P_{1.6}$, $P_{1.7}$ of pins 5, 6, 7 and 8 respectively.

3.2. PIR Sensor

A Passive Infra Red sensor (PIR) is a device used to detect motion by receiving infrared radiation. A PIR detector Combined with a Fresnel lens (FL65) is mounted on a compact size PCB together with an analog ICSB0081 and limited components to form the module. A Fresnel lens is a Plano Convex lens that has been collapsed on it to form a flat lens that retains its optical characteristics but is much smaller in thickness and therefore has less absorption losses. The FL65 Fresnel lens is made of an infrared transmitting material that has an IR transmission range of 8 to 14 µm that is most sensitive to human body radiation. The FL65 has a focal length

of 0.65 inches from the lens to the sensing element [15]. Due to the high sensitivity of PIR sensor device, the TTL output can be directly connected to the micro controller; here it is connected with the port $P_{0.1}$/AD0 at pin number 39 of the AT89C51 microcontroller. Fig 4 and 5 shows the PIR sensor pin description and the sensor detection range. The PIR sensor detection and communication with the local system is explained in the flowchart which is shown in figure9.

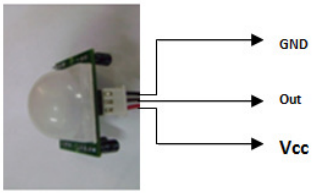


Figure 4: PIR Sensor

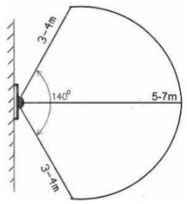


Figure 5: PIR Sensor Range

Figure 5 shows The PIR detects the intruder only if he is in the lens coverage range of 140°, which means 5 to 7 meters from the centre of lens.

3.3. MQ6- Gas Sensor

The MQ6 Gas Sensor Module determines the presence of LPG gas and other bio hazardous gases. The proposed system interfaces the gas sensor module with the microcontroller at the port $P_{0.1}$/AD1 at pin number 38 of the AT89C51host microcontroller. The onboard microcontroller provides initial heating interval after power up and then starts to measure LPG sensor output [3]. If the LPG or the other gas level is in the range of 200 to 10000ppm, then it will inform to the host controller by pulling the output Pin to high and starts to blink the onboard status LED. This sensor module is placed in the movable robot which can be used to detect gas leakage at home and industry, and are suitable for detecting of LPG, iso-butane, propane, LNG. A Sensitive tuner is always available in this sensor module, which is mainly used to manually adjust to set the density of the Gas [4]. The Gas sensor detection and communication with the local system is explained in the flowchart which is shown in figure9. The prototype of the gas sensor module used in this project is shown figure 6. Table 2 shows the sensitivity characteristics, its standard and environmental working conditions.

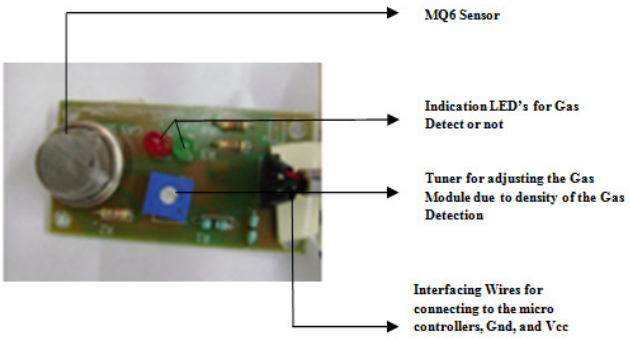


Figure 6: Gas Sensor module

Table 2: MQ6-Gas Sensor Specifications

A. Standard work condition

Symbol	Parameter name	Technical condition	Remarks
Vc	Circuit voltage	5V±0.1	AC OR DC
V_H	Heating voltage	5V±0.1	ACOR DC
P_L	Load resistance	20KΩ	
R_H	Heater resistance	33Ω ±5%	Room Tem
P_H	Heating consumption	less than 750mw	

B. Environment condition

Symbol	Parameter name	Technical condition	Remarks
Tao	Using Tem	-10℃-50℃	
Tas	Storage Tem	-20℃-70℃	
R_H	Related humidity	less than 95%Rh	
O_2	Oxygen concentration	21%(standard condition)Oxygen concentration can affect sensitivity	minimum value is over 2%

C. Sensitivity characteristic

Symbol	Parameter name	Technical parameter	Remarks
Rs	Sensing Resistance	10KΩ - 60KΩ (1000ppm LPG)	Detecting concentration scope: 200-10000ppm LPG , iso-butane, propane, LNG
α (1000ppm/ 4000ppm LPG)	Concentration slope rate	≤0.6	
Standard detecting condition	Temp: 20℃±2℃ Humidity: 65%±5%	Vc:5V±0.1 Vh: 5V±0.1	
Preheat time	Over 24 hour		

3.4. Zigbee Module

The CC2530 zigbee module used in this work is a true system-on-chip solution tailored for IEEE 802.15.4 and is suitable for the low power applications. The CC2530 combines the excellent performance of a leading RF transceiver with an industry-standard enhanced 8051 MCU, in-system programmable flash memory, 8-KB RAM. The CC2530 comes in four different flash versions: CC2530F32/64/128/256, with 32/64/128/256 KB of flash memory, respectively. This project uses 256K flash memory. Short transition times between operating modes further ensures low energy consumption [5]. The range of CC2530 highly depends on antenna design, product enclosure, physical environment including obstructions obstacles environment like temperature and humidity of the air. It is able to achieve 99% packet transmission success with 400m in open-air, line-of-sight, outdoor environment. The Zigbee module is shown in fig 7. The zigbee module's transmitter and receiver is connected with port $P_{3.0}$/RXD at pin number10 and $P_{3.1}$/TXD at pin 11 of the AT89C51 microcontroller. The communication between robot and the local system is a wireless communication using Zigbee. Figure 7(a) shows interfacing RS232 with Zigbee at Local System and figure7 (b) shows interfacing Zigbee at Robot Side.

3.4.1 CC2530 Key Features

- Up to 256 KB Flash/8 KB of RAM
- Excellent link budget (102 dBm)
- 49 dB adjacent channel rejection (best in class)
- Four flexible power modes for reduced power consumption
- Powerful five-channel DMA

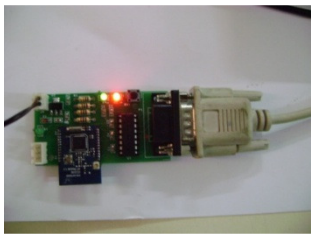


Figure 7(a) Interface RS232 with Zigbee at Local System Side

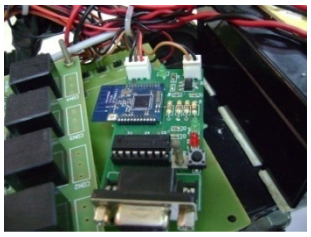


Figure7 (b) Interface Zigbee at Robot

Figure 7: Zigbee module

3.5. DC Motor

A 12V DC geared motors is very easy to use and available in standard size. Nut and threads on shaft is easily connected and internal threaded shaft are easily connecting it to wheel. The 12V DC Geared Motor is used in variety of robotics applications which is available in wide range of RPM and Torque [6]. Fig 8 shows how the DC motor is connected with robotic wheel.

3.5.1 Features

- 30RPM 12V DC motors with Gearbox
- 6mm shaft diameter with internal hole
- 125gm weight
- Same size motor available in various rpm
- 2kgcm torque
- No-load current = 60 mA(Max), Load current = 300 mA(Max)

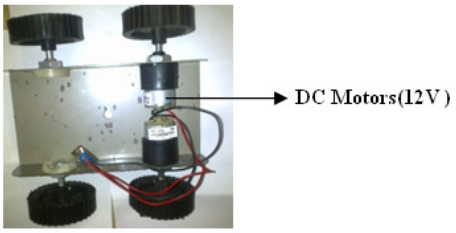


Figure 8: DC motor with Robotic Wheel

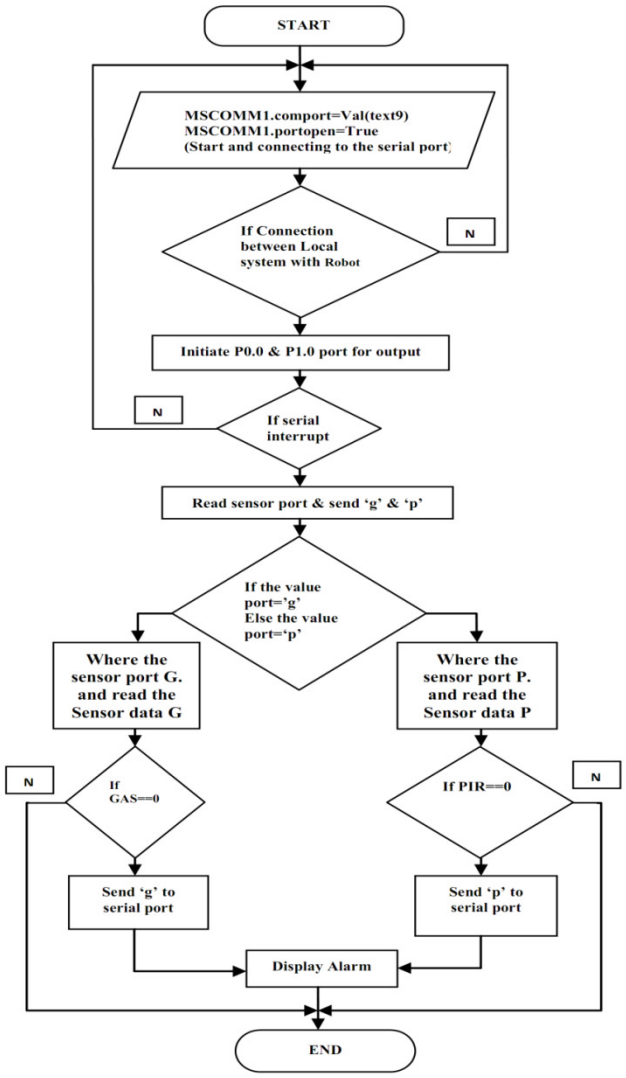


Figure 9: Flow chart for Gas and PIR sensor module

3.6. Relays

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. Relays are used where it is necessary to control a circuit by a low-power signal. The four relays for controlling the robotic movement is shown in fig 10.

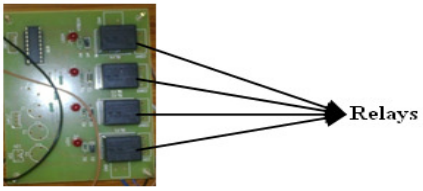


Figure 10: Relays used in the prototype

Table 3: Relay Specification details for Robot Wheel Movement

Relays controlling the Motor directions				
R1	**R2**	**R3**	**R4**	**Direction**
OFF	OFF	OFF	ON	**Left**
ON	ON	ON	ON	**Forward**
ON	OFF	OFF	OFF	**Right**
OFF	OFF	OFF	OFF	**Stop**
ON	OFF	OFF	ON	**Back**

Robot wheel movement is the main process to move the robot wherever the user wants. And the user can easily move the robot by programming the relay control procedure that is fed in to the controller [7]. The relays are driven with the help of ULN2003A driver. It is a driver which is mostly used to activate and deactivate the relays. The following process is maintained by the controller and is accessed by the user. The relays working principle is explained in the flowchart which is shown in figure 11, and also in the table 3. The relay functions are as follows, If relay1=relay2=ON (relay3=relay4=0), the right side motor starts; then the robot turns to **Left** side direction. And relay3=relay4=ON (relay3=relay4=0), the left side motor starts so the robot will be move on **Right** side direction. These both cases are possible only when the other relays value are=0. If relay1= relay4=0 (relay2= relay3=OFF), both the motors starts and the robot will be move **Forward** direction, similarly relay2=relay3=ON (relay1=relay4=OFF), the robot move in **Backward** direction. If all the relays, that is relay1= relay2= relay3= relay4=0 then the motor is said to be in stop condition and hence the robot cannot move. It will remains stop, until anyone of the relay gets started.

3.7. Wireless AV Camera

It is a small and having delicate appearance, good performance with high-quality picture and sound transmitting and receiving. It supports minimum of 100m transmission distance without block and can be used on TV, monitor, LCD, etc. including adaptive bracket and supports easy installation. Wireless video communications are shown in fig 12. The AV signal from the camera is sent to the TV tuner which is connected to the local system through the easy cap (USB 2.0 Grabber). The Audio-Video streaming is done at the local and also at the remote system. This process is explained in the section 6.1 and 6.2.

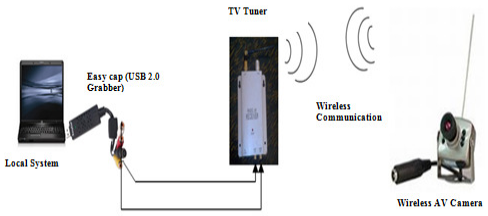


Figure 12: Wireless video communication

3.7.1 Technical Parameters of Transmitting Unit

- Output Power: 50MWOutput Frequency:1.2G/2.4GTransmission
- Signal: Video, Audio Linear Transmission Distance: 50-100M
- Voltage: DC+9V
- Current: 300mA
- Power Dissipation : <=640MW
- Validity pixel: PAL 628x582

- Scan Frequency: PAL/CCIR50Hz
- Sensitivity: +18dB-AGL ON-OFF

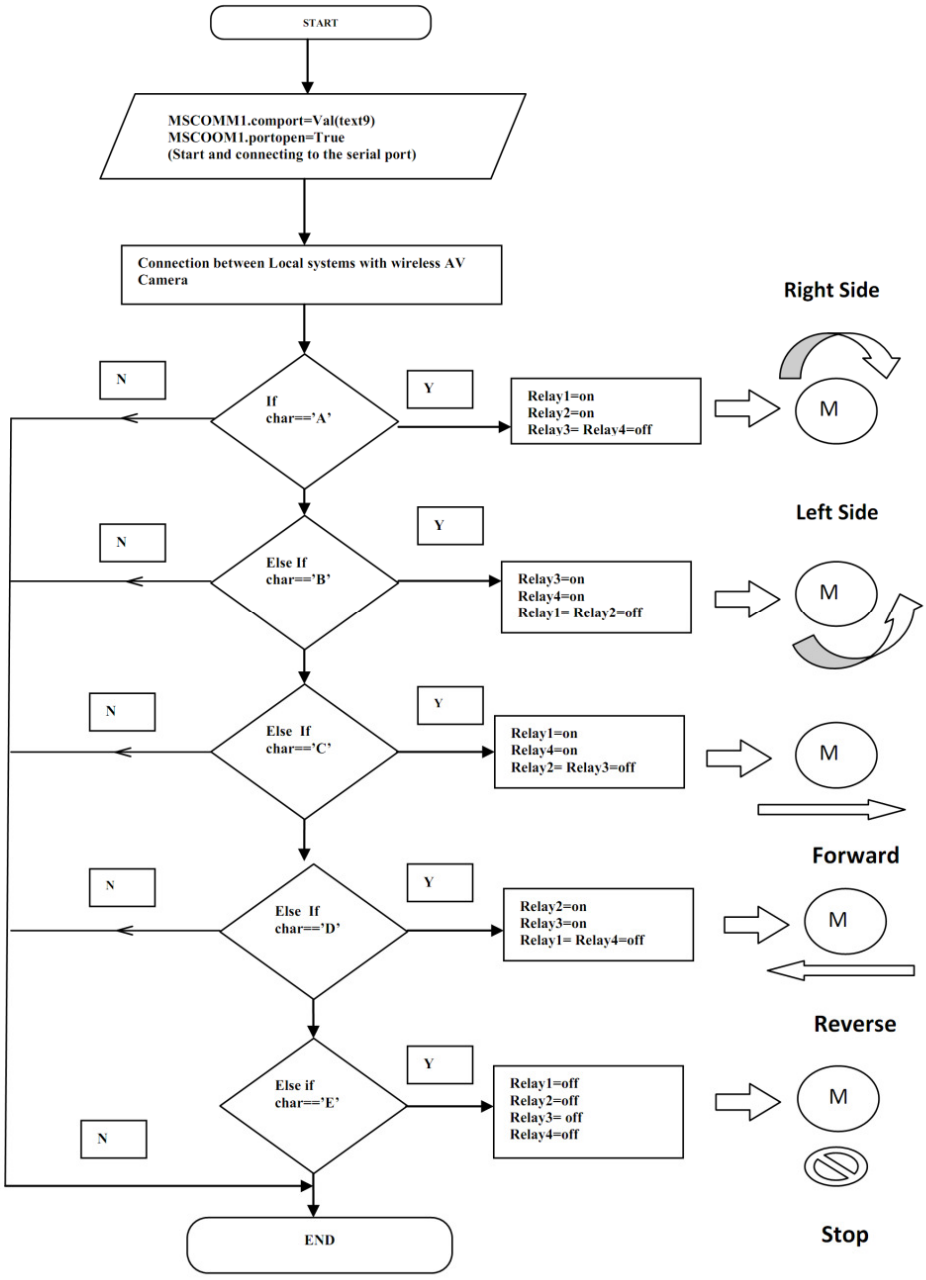


Figure 11: Flowchart for Robotic direction control

3.8 The Easy Cap USB 2.0 Grabber

The Easy CAP USB 2.0 Audio-Video adapter can capture high-quality audio-video files directed by USB 2.0 interface without sound card. However, the installation is very simple and the external power is unnecessary. It is the solution for laptop; we have enclosed the

professional video editing software Tin Cam which provides best editing function. High-speed rendering and real-time performance ensures less waiting time and more time to create. Figure 13 and 14 shows the TV tuner and the Easy cap USB2.0 Grabber.

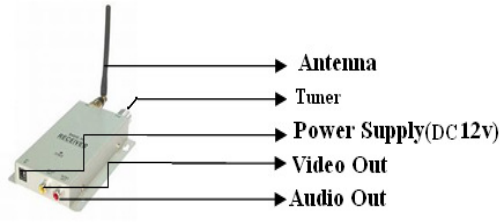


Figure 13: TV Tuner

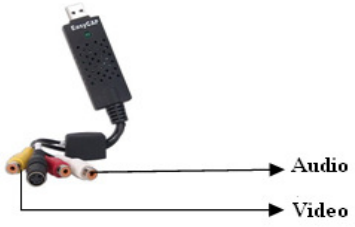


Figure 14: Easy Cap USB 2.0 Grabber

3.8.1 Key Features

- Popular USB 2.0 interfaces and does not need other power.
- Capture Video and Audio though USB 2.0 interfaces.
- Support Brightness, Contrast, Hue, and Saturation control.
- The dimension is suitable, that is easy to carry.
- Could capture audio without the sound card.
- High plug and play.
- Support For All Formats: record in DVD+/-R/RW, DVD+/-VR, and DVD-Video.
- Applying to internet conference and net meeting.

4. SOFTWARE DESCRIPTION

4.1. Embedded 'C'

Embedded C use most of the syntax and semantics of standard C, e.g., main() function, variable definition, data type declaration, conditional statements (if, switch. case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc. In this project Keil cross compiler is used which is one such compiler that supports a huge number of host and target combinations. Use of C in embedded systems is driven by following advantages:

- It is small and reasonably simpler to learn, understand, program and debug.
- C Compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers.
- Unlike assembly, C has advantage of processor-independence and is not specific to any particular microprocessor/ microcontroller or any system. This makes it convenient for a user to develop programs that can run on most of the systems.
- As C combines functionality of assembly language and features of high level languages, C is treated as a 'middle-level computer language' or 'high level assembly language'.

4.2. Steps for Compiling, Linking and Downloading software in to the Microcontroller

Step 1: Create new project
Step 2: Select the device for the Target
Step 3: Add files to the source
Step 4: Build and Link the target program
Step 5: Compile and Debug the program
Step 6: Create Hex file from the source file
Step 7: Download the Hex file using willar programmer
Step 8: Hex file downloaded in to the AT89C51 successfully

4.3. VB front end

In this project visual basic 6 is used as a front end application at the local system and has been used to control the robot through Zigbee connection. This visual basic 6 front end application has mainly 3 forms each form contains some similar data and conditions. Form1 (Login page) is the login page for the security purpose, which provides the authentication to enter in to the next page for controlling the robot and without password any one can access and control the robot. And Form2 (control page) contains the information regarding robotic movement control and process the sensor information from the robot. According to the PIR and Gas sensor data, it displays the "Gas detected" and "Intruder detected" message at the front end application and immediately it calls the emergency form page (Form3). Form3 (Emergency alert page) performs the audio and visual alarm process for the security purpose. Figure 15 shows the VB front end application form wizard.

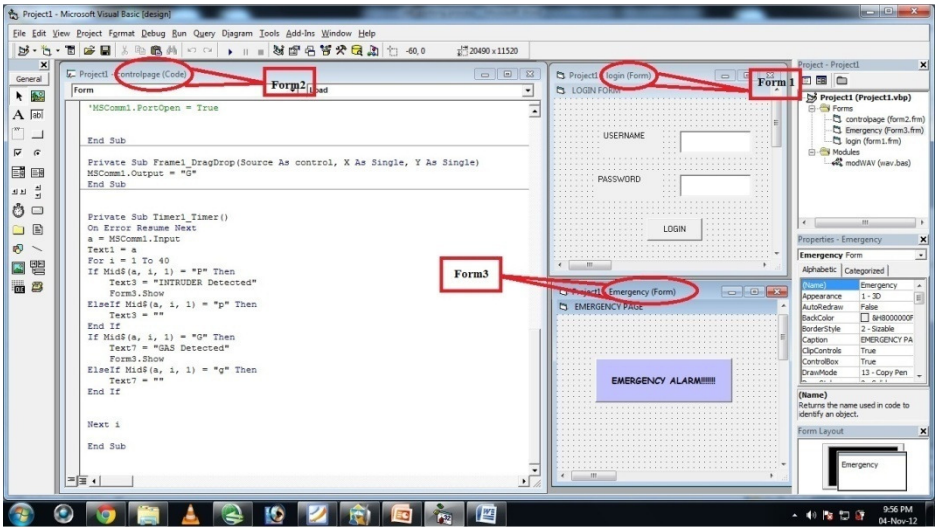


Figure 15: VB Front end application wizard

4.5 Tin Cam Software Specifications

Tin Cam can upload the pictures with FTP and simply save the pictures to a specified folder. The Windows Media Video format is used for streaming both audio and video signals. Tin Cam can create and upload a webpage that displays the webcam pictures or video stream. It allows writing text on the page, changing colors and adding a background pictures. Tin Cam can insert a caption on the webcam pictures, captions can contain time and date, and can be loaded from an external text file.

5. Results and Implications

The prototype of the robot is shown in the figure16. The robot has four wheels which are used for moving backward, forward, left and right turns. The Zigbee at the robotic side is used for transmitting the data from microcontroller to the local system [9]. The proposed robot is a battery powered and compact system. Fig 17 shows circuit diagram of the proposed system.

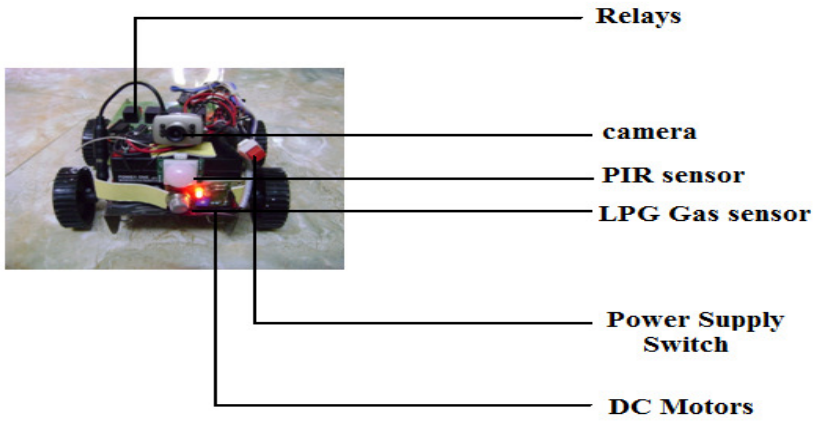


Figure 16: Prototype of the proposed system

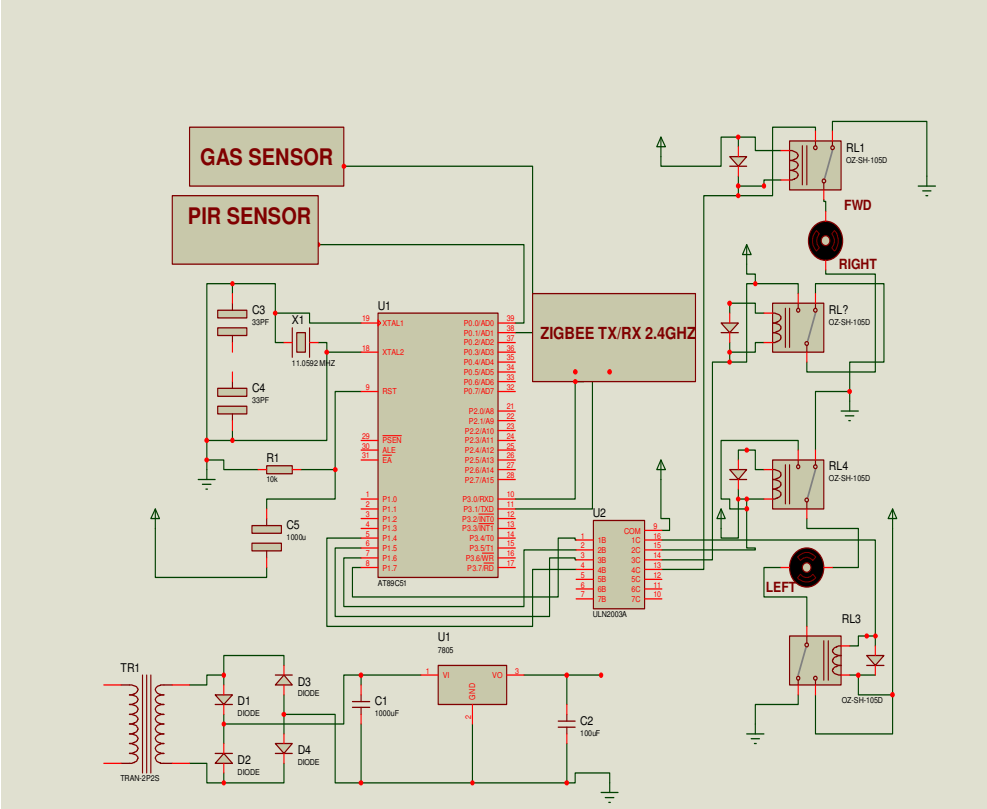


Figure 17: Circuit diagram of the proposed system

5.1 Audio-Video streaming and Robotic movement control at local system

The following steps shows the how the alert information are viewed at the local system on detecting the Gas and Intruder. And also shows the wizard for Audio-Video streaming.

Step 1: Login page

This wizard shows the login page at the local system, in which the authenticated user only can enter the username and password, and only if the password is correct it will show the following pages and allows controlling the robot.

Step 2: Gas Detection

Figure 18 shows the detection of LPG Gas, where the LPG Gas container is placed near to the Robot for the demonstration purpose [10]. The sensitivity for detecting the concentration scope for the bio-hazardous gases like LPG, iso-butane, propane and LNG are from 200 to 10000ppm. The Gas detection is indicated by red LED glow at the robot. Our Robot has detected the presence of LPG gas in its environment and we controlled and moved the robot near to the gas leakage source (Figure 18).

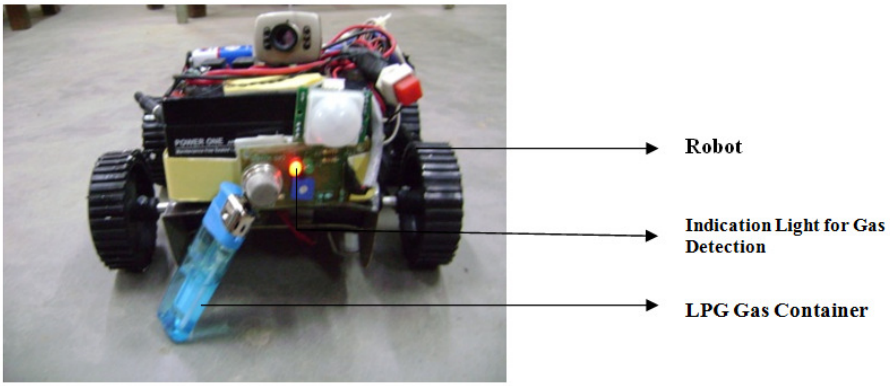
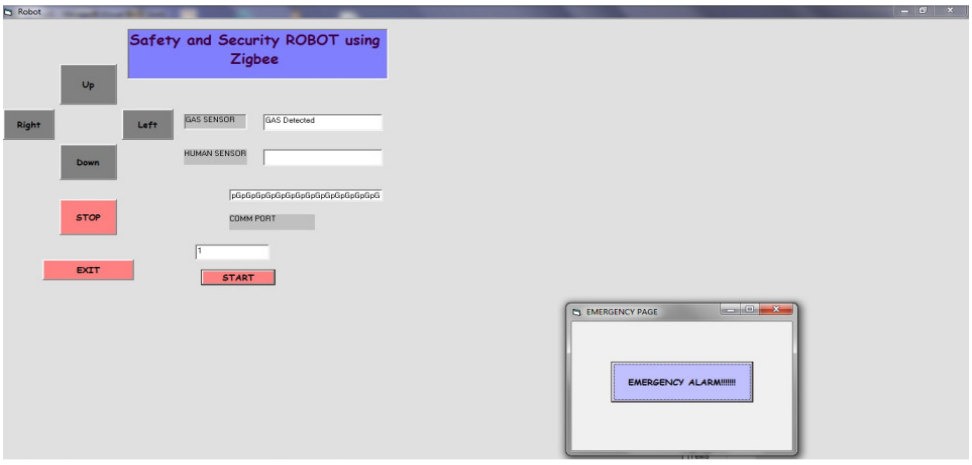


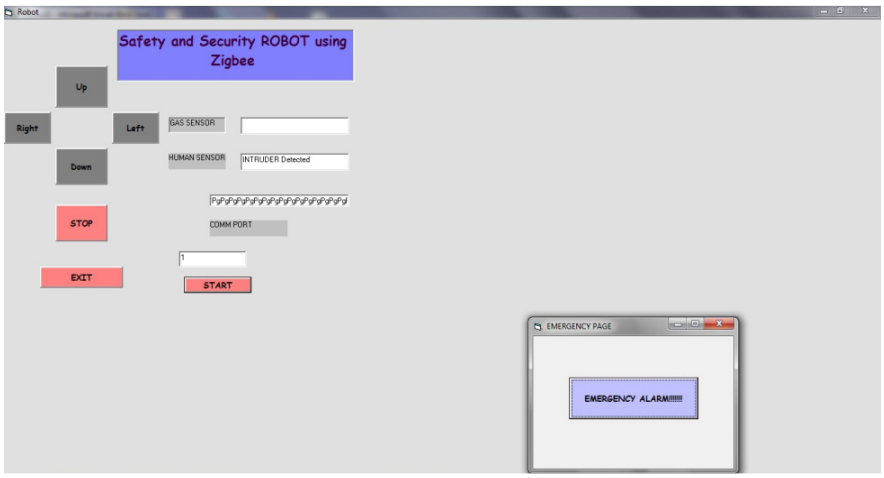
Figure 18: Gas Detection



Implication 1:

The presence of gas is detected by the gas sensor, and then the same information is sent to the local system where it provides the audio and visual alert message which is shown in the above wizard. This alert information is highly helpful to avoid the disaster due to life threatening hazardous gas leakage. We have tested this in our chemistry lab, where we have chemicals and gases which are highly inflammable.

Step 3: Intruder Detection



This window shows the intruder detection by the PIR sensor and provides alarm about the security status. TV Tuner is connected to the Local System through RF Wires with Easy Cap USB2.0 Grabber and transfers the Audio and Video signal from the wireless AV Camera as shown in figure 19. Zigbee is connected to the Local System through RS232 9 pin interface.

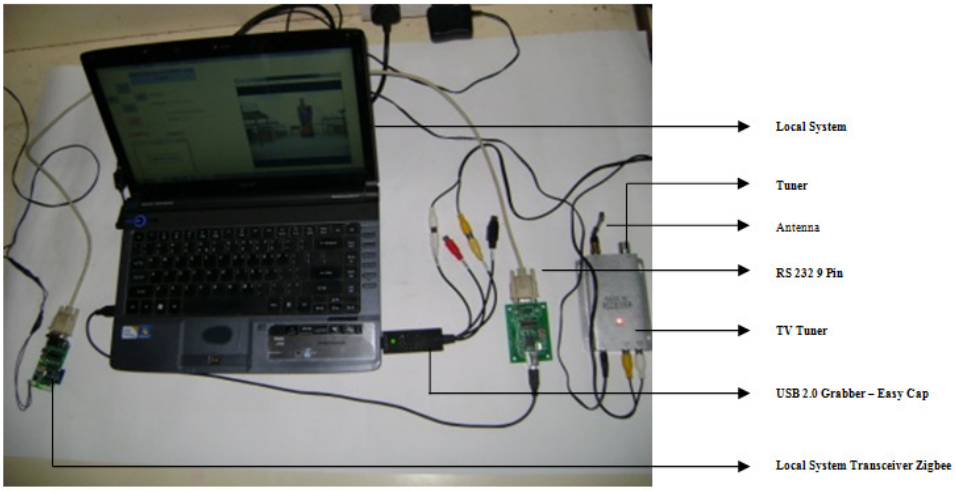


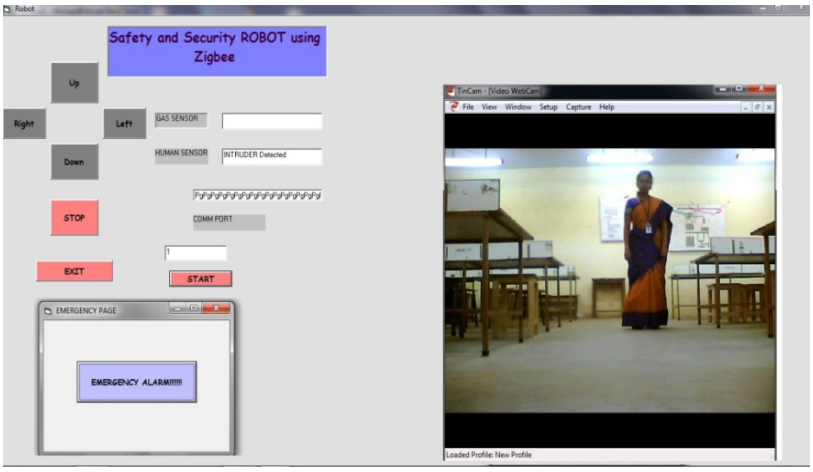
Figure 19: Interfacing TV tuner and Zigbee with the Local System

Implication 2:

We have communicated the sensor information from the robot to the local system and controlled the robot through zigbee communication (figure 7 and 19). The zigbee is operated on battery power with sleep mode which reduces the battery use. There is less probability of interfering with other users, since it incorporates CSMA-CA protocol and also supports

automatic retransmission of data which ensures the robustness of the network. The distance between the robot and the local system supported by zigbee is 400ms only and hence the distance can be further more increased by using zigbee-pro which can support several kilometers depends on the cost. It facilitates ease-of-use and supports larger networks that comprised of thousands of devices. Our system supports interoperation with each other (zigbee and zibee-pro) and ensures long term use and stability.

Step 4: Audio-Video Streaming on Tin Cam



This page shows the video and audio buffering on Tin Cam software. We can easily adopt both windows in a same window. So it is very helpful to know the recent status of robot and detections of audio and video from wireless AV camera.

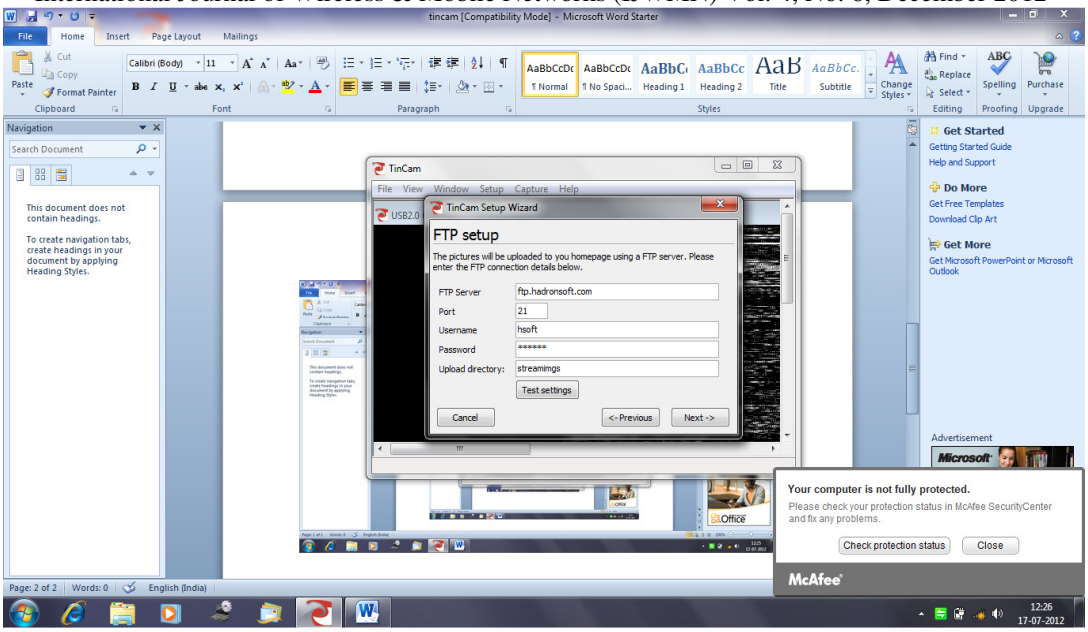
Implication 3:

In intruder detection, we have tested the security feature in our computer laboratory. The PIR sensor present in the robot senses the presence of intruder in a particular area and immediately provides a security alarm at the local station (Step-3 wizard). The low cost wireless AV camera at the robot captures its in-front audio and video information and performs AV streaming at the local system through Tin cam (step-4 wizard). This system is really helpful where security is a major threat. And also be useful to detect the people who were alive in the disaster situations to save the valuable human lives where we cannot go and find them.

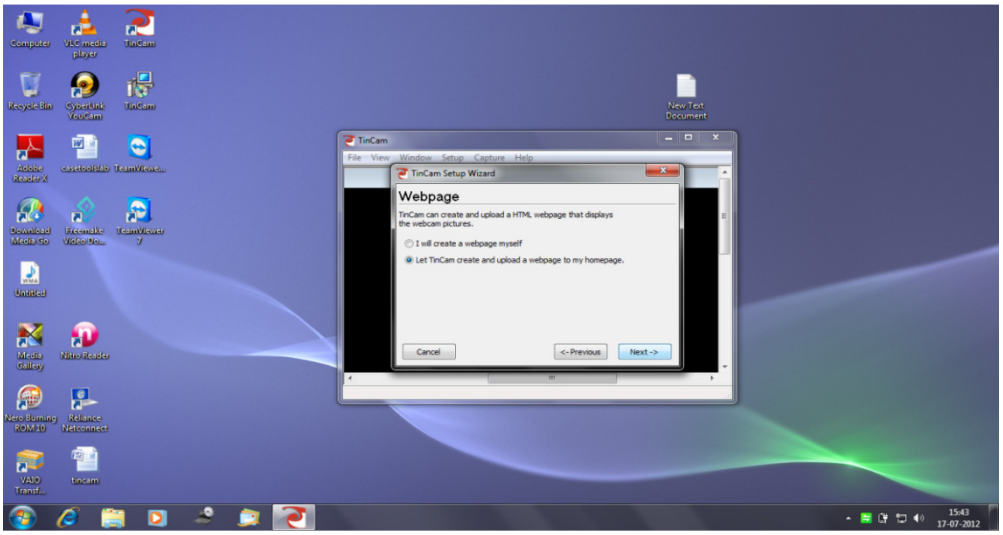
5.2 Configuring Tin Cam with FTP server.

The following steps are the main procedure to upload the audio and video in FTP web server through Tin Cam. These steps are used to configure the Tin Cam with FTP server.

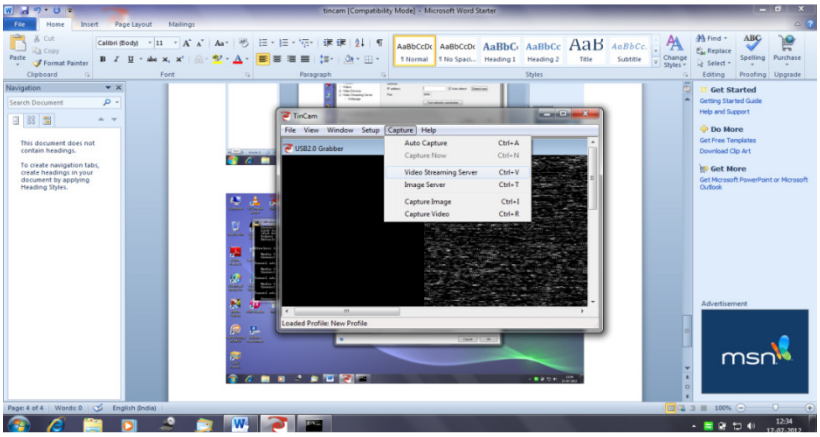
Step 1: Select USB 2.0 Grabber for connecting with the AV Wireless Camera driver interface card (EASY CAP). It can be viewed by clicking after setup menu and select “setupwizard” then enter the FTP connection details to update the video and audio to FTP Server, the process is shown in the following wizards.



Step 2: The wizard shown below is used to create the web page by us or the software. Tin Cam can easily create its own web page to upload the video and audio on FTP server. Then Select the appropriate options that are given below. Here we select Tin Cam to create and upload the video and audio through webpage. The number of frames per second to buffer can be assigned by us according to the speed of our network.



Step 3: Check the pointer that select USB 2.0 Grabber and insert the local System's IP address in the required box. To know the IP address of the Local System, go to command prompt and type "**IPCONFIG"**. The IP address should be correctly typed without misspelled in IP address bar and deselect the "Auto detect" button. If you are having doubt in your network you can re-test your connection by clicking the "Test network connection" button. After that go to capture menu, then select Video Streaming Server to upload the video and audio streaming at the webpage also at the FTP web server.



Step 4: After finishing the entire above setup wizard, then go to internet explorer or any relevant web browsing application then type this URL address "hadronsoft.com/streamimgs/webcam.html" to display the video and audio information at robot environment. Figure 20 shows the Audio and Video streaming at the web server and figure 21 shows AV streaming on 'N' number of Remote system.

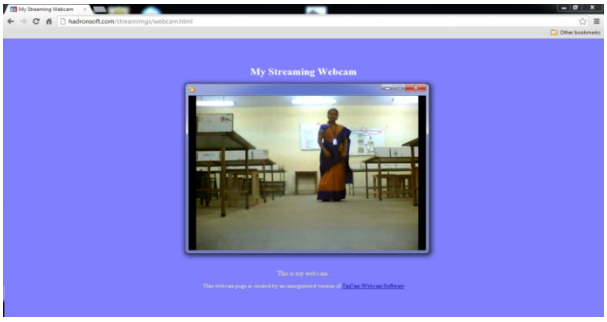


Figure 20: Audio-Video streaming at Web server

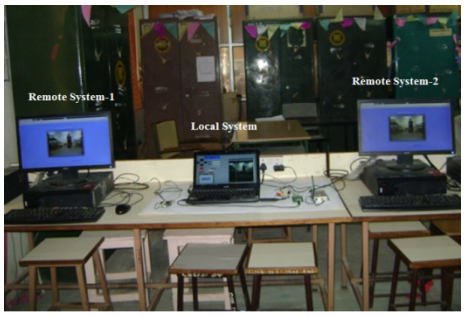


Fig 21: Audio-Video streaming on 'N' Number of Remote system

Implication 4:

We have tested and performed video streaming both in the local system and 'N' number of remote systems (figure 21). So any user can easily access the audio and video streaming at anywhere in the world. The tin cam supports the user in selecting the number of frames per second and if we increase the number of frames then we can get good resolution in AV streaming. In our system we select five frames per second (step 2). Tin cam also supports different protocols like TCP/IP, ISP, HTTP and FTP. We have uploaded the audio and video signals to the FTP web server (step 1, 2 and 3) through tin cam (figure 20). And hence this gives higher priority for security purpose.

6. CONCLUSION

The proposed robot can be used in war field, mines, power station, military operations, industries, research and educational institutions and so on. And also be used wherever people cannot go or where things doing too dangerous for humans to do safely. The Robotic movement is controlled remotely through the local system. The presence of bio hazardous gases like LPG,

iso-butane, propane, LNG and alcohol were detected through MQ6 Gas Sensor which is placed at the robot. Similarly the intruder (Human or Animal) entered into the room/ range is detected through the PIR sensor. The above two sensed parameters were sent to the local system through the zigbee communication which is presented at both the ends, that is at the robot and at the local system. And at the same time an audio and visual alarm is raised [11]. A wireless AV camera resides at the robot; send's the robotic environment information to the local system. The video streaming is simultaneously done at both the local and 'N' number of remote system (web server). TV tuner is the source to receive the video signals from wireless AV camera and send that signals to the Local system using RF wires. The videos are streamed using the Tin Cam software, this software is used to create a web page to do live streaming through the web server. This system can be used where ever the safety and security are the major threat. In future this work may be enhanced in such a way that, whenever a picture is captured then a Tin Cam can immediately send an email about the picture. And also zigbee-pro may be used to increase the communication distance between the Robot and with the local system.

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