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MILITARY ROBOT USING RF TRANSMISSION

Dr.R.Prakasam,
[1] Principal, PPG Institute of Technology,
[2]Coimbatore, Tamil Nadu.

P.Radhika,
[1] AP/Mechatronics, PPG Institute of Technology,
[2]Coimbatore, TamilNadu.

Abstract— Our goal is to develop an intelligent gun tracing and fire fighting robot for military applications. The licensed guns of soldiers are designed using HT12E encoder and RF Transmission. The theft gun tracing system in the robot is developed with RF receiver and transmitter. The fire detection system is equipped with thermistors/flame sensors in the robot that continuously monitors the temperature.
If the fire accident is true, the robot moves to the direction in which the temperature is recorded to be maximum and extinguishes the fire with water pump provided in it. The military robot is programmed to detect the theft guns and fire accidents using sensor based method. The robot can be also be used in airports, railway stations, industries and in public areas.

I.INTRODUCTION

A Robot is a mechanical design capable of performing human tasks. The robot can estimate the usage of theft guns in airports, railway stations, industries and also in public areas [3]. Fire fighters in boundary areas face risky situations while extinguishing fires and rescuing victims. The robot provides fire protection using microcontroller when there is fire in a tunnel. The robot is programmed using PIC18F4520 Microcontroller. The robot can be used in military applications and also in boundary areas [2].

The robot can operate in two modes namely automatic mode and user mode. In automatic mode the user has no control over the robot. The robot takes it own decisions and performs the required operation using Artificial Intelligence. At unavoidable circumstances the control automatically goes to user mode. The robot can be fully controlled from remote location to perform the required operation [5].

II.GUN TRACING SYSTEM

The theft licensed guns designed and manufactured with HT12E encoder and RF transmitter can be detected using RF receiver and PIC Microcontroller in the robot. The gun detected signal will be sent to the control unit for further action.

III. FIRE DETECTION SYSTEM

The fire extinguisher uses flame sensors in the robot to detect fire accidents. When the flame is detected, the robot sends the fire detected signal to control unit. The Microcontroller sounds the alarm with the help of buzzer. The robot actuates an electronic valve and it releases sprinkles of water on the flame. The robot after extinguishing the fire continues to move in the autonomous mode.

IV.WORKING PRINCIPLE

When the theft gun enters the vicinity of the robot, the gun detected signal will be sent to the microcontroller in the control unit through RF transmission. The receiver in the control unit receives the gun detected signal with an alarm so

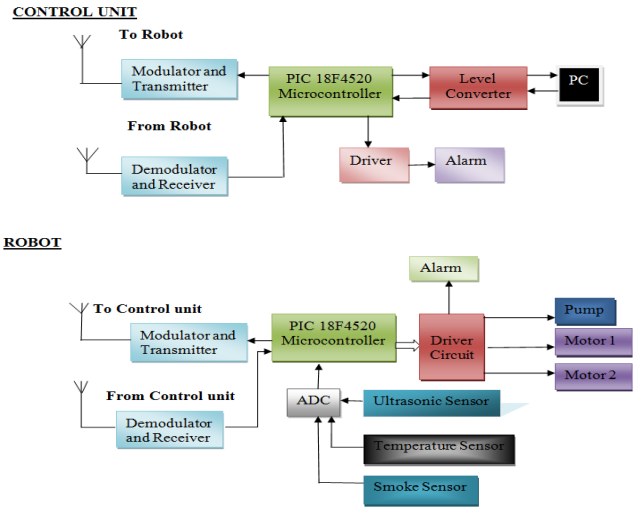

FIGURE 1: SYSTEM MODEL

that necessary action can be taken [5]. When the robot senses fire, the fire detected signal is sent to the control unit through RF transmitter.

The fire detected signal is received in the control unit through RF receiver. When the microcontroller receives the fire detected signal, it sounds the alarm with the help of buzzer. The robot rotates 1 feet towards left, when it hits with an obstacle in the right side and vice versa.

V.FLOWCHART

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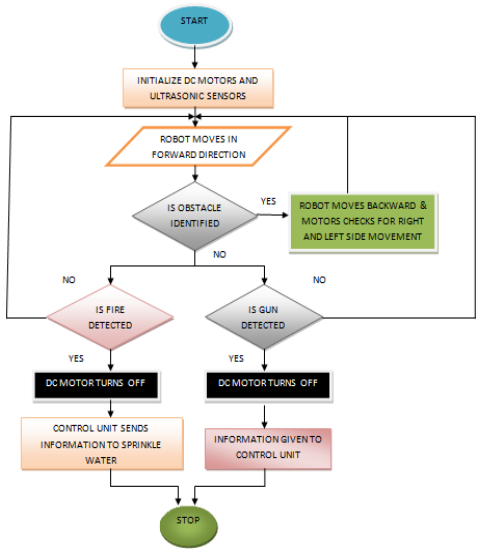

VI.SYSTEM COMPONENTS

The robot is designed with hardware elements like PIC Microcontroller, Encoders, Drivers, motors, flame sensors, Ultrasonic sensors, smoke sensors, pump, sprinkle, castor wheel, RF Transmitter and RF Receiver and wires.

A. MICROCONTROLLER

Building a robot requires complex programming. The designed robot uses PIC18F4520 Microcontroller both in the robot and control unit. The actions performed by the robot are written as coding in PIC18F4520 microcontroller using embedded C language. The microcontroller has program memory, data memory, Input/Output ports and support devices.

The Microcontroller used in the robot is PIC 18F4520. It has 40 pins. The operating frequency of the microcontroller is DC- 40 MHZ. The program memory has 32768 bytes. The data memory has 1536 bytes. The data EEPROM has 256 bytes. The Input/ Output Ports are Ports A, B, C, D, E.

In Pin 1, MCLR is the Master clear input, VPP is the programming voltage input and RE3 is reset to the device. Pin 2 & 3 are the Digital I/O, Analog input 0 & 1. Pin 4 is the Digital I/O, Analog input 2, A/D reference voltage (low) input and Comparator reference voltage output. Pin 5 is the Digital I/O, Analog input 3 and A/D reference voltage (high) input. Pin 6 is the Digital I/O, Timer0 external clock input and Comparator 1 output.

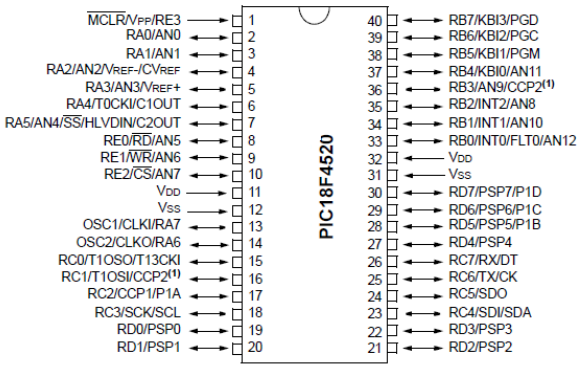

FIGURE 2: PIN DIAGRAM OF PIC MICROCONTROLLER

Pin 7 the Digital I/O, Analog input 4, SPI slave select input, High/Low-Voltage Detect input and Comparator 2 output. Pin 8 is the Digital I/O, Read control for Parallel Slave Port and analog input 5. Pin 9 is the Digital I/O, Write control for Parallel Slave Port and analog input 6. Pin 10 is the Digital I/O, Chip Select control for Parallel Slave Port and analog input 7 [5][7]. Pin 15 is the Digital I/O, Timer1 oscillator output and Timer1/Timer3 external clock input. Pin 11 & 32 is VDD is VDD. Pin 12 & 31 is VSS. Pin 13 is Oscillator crystal or external clock input. Pin 14 is Oscillator Pin 16 is Digital I/O, Timer1 oscillator input and Capture 2 input/Compare 2 output/PWM2 output.

Pin 17 is the Digital I/O, Capture 1 input/Compare 1 output/PWM1 output and Enhanced CCP1 output. Pin 18 is the Digital I/O, Synchronous serial clock input/output for SPI mode and Synchronous serial clock input/output. Pin 19, 20,21, 22, 27 are the Digital I/O and Parallel Slave Port data. Pin 23 and 24 are Digital I/O, SPI data in/out. Pin 25 and 26 are Digital I/O, EUSART asynchronous transmit/receive. Pin 28, 29, 30 are Digital I/O, Parallel Slave Port data and Enhanced CCP1 output. Pin 33, 34, 35 are Digital I/O, External interrupt 0/1/2. Pin 36 is the Digital I/O and analog input 9.Pin 38, 39 and 40 are the Digital I/O, Interrupt-on-change pin [1][2].

B.TEMPERATURE SENSOR

The temperature sensor used is thermistor. It is a resistor whose resistance varies with temperature. It can sense temperature within the boundary area. The microcontroller will scan the input signal of sensors. The microcontroller pin will reach low level when fire is sensed.

The fire sensor in the robot is a commercial security device that issues a signal to the fire alarm control panel (i.e Microcontroller) as part of a fire alarm system. Thermistor is a combination of the words thermal and resistor. It can be classified into two types depending on the sign of k. If k is positive, resistance increases with increasing temperature, and the device is called a positive temperature coefficient (PTC) thermistor. If k is negative, resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (NTC) thermistor. NTC is used in the robotic system for temperature determination.

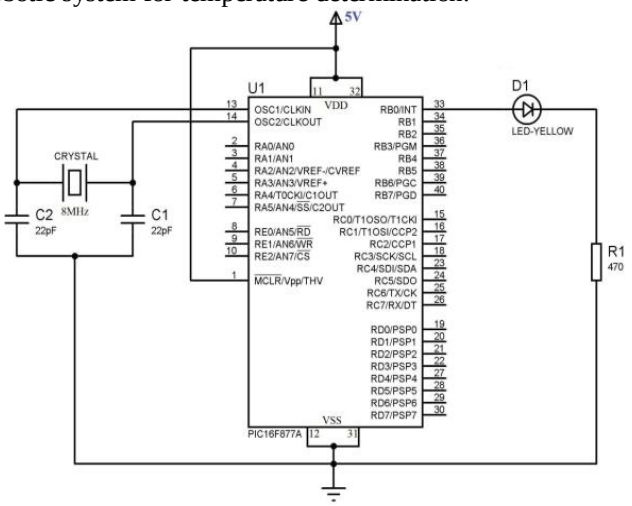

FIGURE 3 : PIN DIAGRAM OFMICROCONTROLLER

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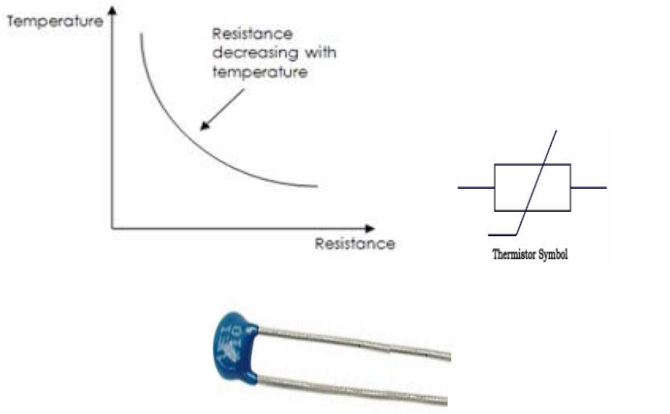

FIGURE 4: THERMISTOR WORKING PRINCIPLE AND SYMBOL

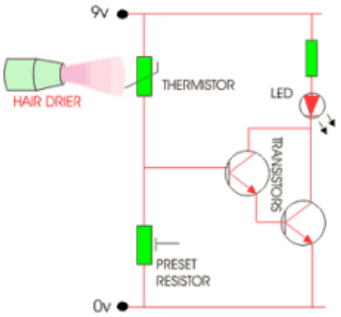

FIGURE 5: THERMISTOR CIRCUIT

The fire sensors are capable of detecting fire around 2 meters. The analog signal from thermistor is amplified and sent to the microcontroller. The fire extinguisher works till the water tank becomes empty.

It is more advantageous than a smoke detector as it can extinguish the fire at the inception than waiting for an object to burn and produce smoke [14].

C. SMOKE SENSORS:

A smoke detector senses smoke, as an indicator of fire. It is housed in plastic enclosures, shaped like a disk about 150 millimetres in diameter and 25 millimetres. Smoke can be detected either optically (photoelectric) or by physical process (ionization). The photodetector senses the lack of light and sends the signal to microcontroller with alarm signal [14].

The smoke would have to be thick enough to completely block out the light. Photoelectric smoke detectors uses light in a different way. Inside the smoke detector there is a light and a sensor, positioned at 90-degree. In the normal case, the light from the light source on the left shoots straight across and misses the sensor. When smoke enters the chamber, the smoke particles scatter the light and some amount of light hits the sensor and the signal is given to the microcontroller [5][7].

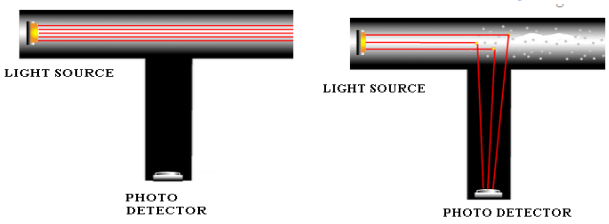

FIGURE 6 : SMOKE DETECTOR

D.ULTRASONIC SENSOR

The ultrasonic sensor makes use of ultrasonic waves to sense an obstacle in its path and deviates or stops its journey. The circuit consists of ultrasonic transmitter and receiver similar to LED. It is also called as transceivers as it can send and receive the ultrasonic signal, but more generally called as transducers [14].

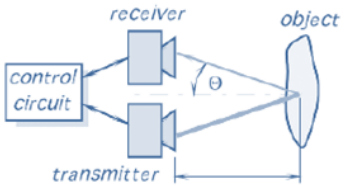

FIGURE 7: ULTRASONIC SENSOR

The transmitter continuously transmits the ultrasonic rays. The sensor is connected to the pins of the microcontroller and takes any action depending upon the feedback received from the ultrasonic sensor. Its operating voltage is 1.4V. At the output pin, voltage is approximately 5v. Here the microcontroller controls the movement of the robot and reads the input from the sensor unit. The ultrasonic sensor calculates the time interval between transmitted ultrasonic signal and received ultrasonic signal to determine the object.

E.ENCODER

The gun is designed with an encoder (HT12E) and a RF transmitter. The encoder generates 8 bit address and 4 bit data. The security code of the gun and the encoder generates 4bit data and 8 bit address. The signal is then sent to the robot using RF transmitter. The transmitting frequency is 433MHz. The transmitter output is up to 8mW at 433.92MHz.

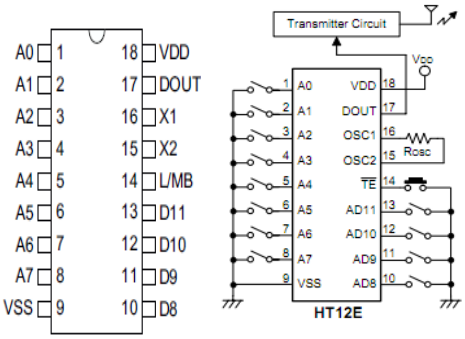

FIGURE 8: HT12E ENCODER PIN DIAGRAM AND CIRCUIT

HT12E is an encoder integrated circuit of 2^{12} series of encoders. They are paired with 2^{12} series of decoders for use in remote control system applications.

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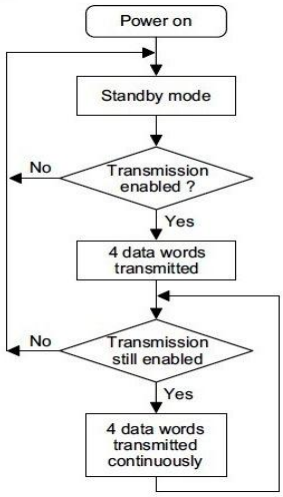

FIGURE 9: HT12E ENCODER WORKING

It is mainly used in interfacing RF and infrared circuits. The encoder will always be in standby mode. When the transmission is enabled, 4 data words will be transmitted from the encoder to the RF transmitter else the encoder will be in standby mode. If the transmission is still enabled then the 4 data words will be transmitted continuously.

F.MOTORS

The robot consists of 2 DC motors to rotate the wheels of the robot. In the automatic mode, the motor moves in the forward direction. In the manual mode, the motor moves as per the instruction from the user.

FIGURE 10: DC MOTOR DRIVER

The PIC Microcontroller operates at 5v. The DC Motor operates at 12v. So H-bridge driver is used as an interface between microcontroller and DC motor. The driver circuit is made of one transistor and one relay. It is operated by the Microcontroller. The Microcontroller changes the state of the output pin from low to high, i.e. from level 0 to level 1. The transistor will act as an ON/OFF switch corresponding to the input of the base. If the base current of the transistor is high the transistor is under ON condition else it is in OFF state. These conditions will be used to control the relay.

G.ANALOG TO DIGITAL CONVERTER

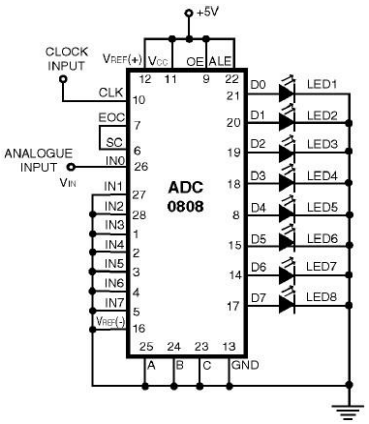

FIGURE 11: ANALOG TO DIGITAL CONVERTER

ADC 0808 is a simple Analog to Digital converter circuit based on 8 bit. It is an interface between microcontroller and sensors to convert analog information into digital format. ADC0808 has data output lines D0-D7. ADC0808 has eight analog input channels, in which any one input signal from fire sensor, obstacle sensor and smoke sensor works with address lines A, B and C. The robot chooses input channel IN0 by grounding A, B and C address lines. The control signals ALE (address latch enable), EOC (end of conversion), OE (output enable) and SC (start conversion) are interfaced by microcontroller. During analog to digital signal conversion, EOC signal goes high.At next clock pulse EOC output again goes low and SC is enabled to get started on the next conversion. Thus, it delivers continuous 8-bit digital output corresponding to instantaneous value of analogue input. The optimum level of analog input voltage ought to be properly scaled down below positive reference (+5V) level. LED is connected to data output lines D0 through D7.

H. LEVEL CONVERTER

MAX 232 is the level converter used for the communication between PIC microcontroller and the PC. The MAX232 IC has 16 pins. Pin 1 is connected to the positive lead of C1 capacitor. Pin2 is given to Positive charge pump output for storage capacitor. Pin 3 is given to Negative lead of C1 capacitor. Pin 4 is connected with Positive lead of C2 capacitor. Pin 5 is connected to Negative lead of C2 capacitor. Pin 6 is Negative charge pump output for storage capacitor. Pin 7 and 14 is given to RS232 line data output (to remote RS232 system). Pin 8, 13 is given to RS232 line data input (from remote RS232 system). Pin 9, 12 is given to Logic data output (to UART). Pin 10, 11 is connected with Logic data input (from UART). Pin 15 is connected with ground and pin 16 is connected to Supply Voltage, Connect to external 5V power supply

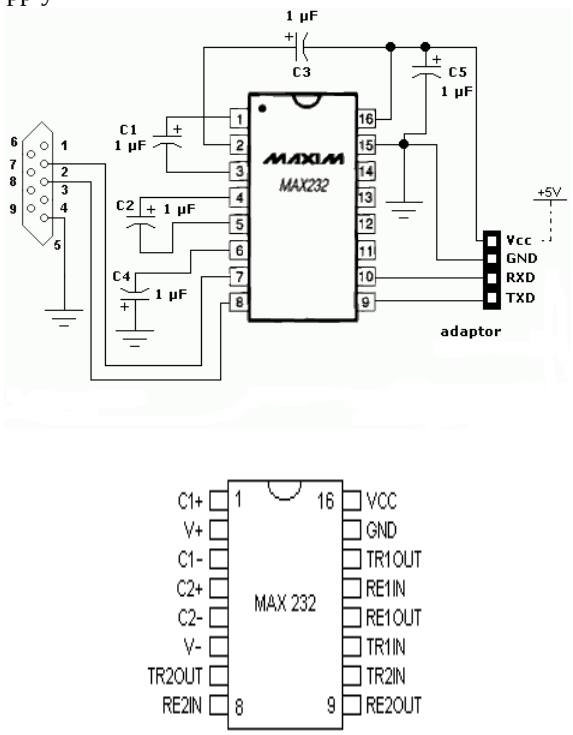

FIGURE 12: PIN & CIRCUIT DIAGRAM OF MAX232

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The MAX232 device is a dual driver/receiver that includes a capacitive voltage generator to supplyvoltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5v CMOS levels. Each driver convertsTTL/CMOS input levels into TIA/EIA-232-F levels [5][7].

I. BUZZER

Piezo buzzeris an electronic device used to produce sound. It is based on the inverse principle of piezo electricity. It generates electricity when mechanical pressure is applied. When subjected to an alternating electric field they stretch or compress, with the frequency of the signal and produce sound. The buzzer is lightweight, simple in construction and low price. It can also be used in applications like car/truck reversing indicator, computers, call bells etc.

FIGURE 13: BUZZER

J.POWER SUPPLY

The input power supply is 230v AC. It is stepped down to 12V AC using a step down transformer. Then the output is given to the full wave rectifier. The rectifier eliminates the negative peak voltage of the input voltage.The output of the rectifier is the pulsating dc signal. The error pulses are eliminated using capacitor filter and the output voltage will be 12v dc. To convert the 12v dc into 5v dc a regulator (7805) is used in the power supply. The output of the regulator is constant irrespective of the input voltage[5][7].

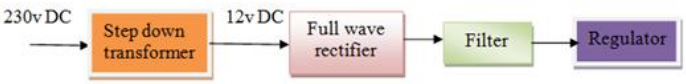

FIGURE 14: POWER SUPPLY

K. RF TRANSMISSION

Radio Frequency (RF) transmission uses radio signals to transmit audio by a carrier from a transmitter to a receiver. Like a radio station transmitter, the transmitter has an antenna attached to the transmitter unit which needs to be positioned to adequately cover the listening area. The receiver units are either single channel or multi channel and they receive the modulated radio waves and convert them back into an audio signal.

Multichannel receivers will have a channel selector which allows a user to select a specific transmission channel. Since the antenna may pick up thousands of radio signals at a time, a radio tuner is necessary to tune in to a particular frequency (or frequency range). This is done by a resonator with a capacitor and an inductor forming a tuned circuit.

The resonator amplifies oscillations within a particular frequency band. Often the inductor or the capacitor of the tuned circuit is adjustable and allows the user to change the frequencies at which it resonates.

L.RF TRANSMITTER

The TWS-434 transmitter is used for short-range RF remote controls. The TWS-434 transmitter is placed inside a small plastic enclosure. The transmitter is given a power supply of 5V. The output power of the transmitter is up to 8mW at 433.92 MHz. The coverage area of the transmitter will be 400 foot in open area or in the outdoors and in indoor the coverage area will be about 200 foot. The TWS-434 transmitter accepts both linear and digital inputs can operate from 1.5 to 12 Volts-DC. The input from the encoder is given to pin-2. The power supply is provided in the pin-3. The RF output is produced in the pin-4, where the antenna is connected [4].

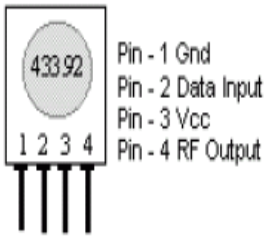

FIGURE 15 : RF TRANSMITTER

The transmitter transmits 4 words for each transmission of the signal. The 4 bit data from the pin 17 of the encoder moves to the data input pin of the transmitter and from there the data is transmitted through the antenna.The voltage consumed by the transmitter will be about 2.85v in the encoder. The carrier frequency is 433MHZ [12].

M. RF RECEIVER

The receiver RWS 434 also operates at 433 MHz. The receiver has a sensitivity of 3µA. It operates at 4.5V to 5.5V. The output produced by receiver can be either linear or digital. The distance between the pin1 and pin 8 is 43.5mm. The distance between the pin4 and pin5 is 25.4mm. The digital output will reach the decoder from pin2 and the linear output will be present in the pin 3.The receiver RWS 434 section is used along with the HT-12D decoder IC for a 4-bit RF remote control system. For maximum range, the antenna size can be increased from 30-35cm

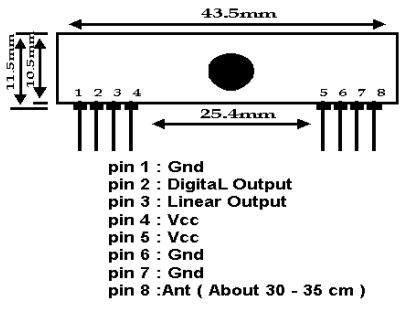

FIGURE 16: RF RECEIVER

VII.ADVANTAGES

- Usage of theft licensed guns can be estimated in the surrounding area.
- The robot can detect and extinguish fire without human aid.
- It can save human lives and mitigate the risk of property damage.
- The robot can prevent dangerous accidents.
- Minimization of ecological consequences and financial loss.
- In case of uncontrollable situations in autonomous mode, the robot can switch over to manual mode.

VIII. APPLICATIONS

The designed robot can also be used in large commercial, industrial, and residential buildings powered with a central fire alarm system.

IX. CONCLUSION

In this paper, the designed robot autonomously monitors and extinguishes fire along with environmental sensing and proportional motor control.In case of high fire, it intimates the respective personnel in the control unit and the robotic control switch over to manual mode.Incase of fire accidents in industries, we need men from fire service to rectify it.

Time delay in this process causes human loss and property loss. The fire fighting and rescue activities are executed without putting fire fighters at risk by using robot technology instead.

X.FUTURE SCOPE

The robot can extinguish fire only in its path and not in all the rooms. It can be extended to a real fire extinguisher by replacing the water carrier. The robot can identify only one sensor at a time. The gun detection system can be enhanced with bomb detection and Intruder detection in the boundary area. Also the robot could not run through the batteries at some conditions.

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AUTHORS

Dr.R.Prakasam has completed B.E.(Honours) in Mechanical Engineering from Madras University in 1981 and Master degree in Engineering - M.E. in Production Engineering in 1986 from Bharathiar University. He finished his doctoral degree - Ph.D from Bharathiar University in the field of Energy in 2002.

He served in SITRA, Coimbatore for about 27 years at various levels and he left SITRA in 2007 as Assistant Director and Head of Textile Engineering and Instrumentation Division.He joined Habasit AG, Romerstrasse, Reinach, Switzerland as Vice President (R&D in Modular Belts Development) from 2007 to 2010.He has served as Principal in GanadipathyTulsi's Jain Engineering College, Vellore from 2010 to 2013. He has joined PPG Institute of Technology as CEO cum Principal in July 2013.

He is a recipient of several National and International Awards like Merit Award from Government of Tamil Nadu in 1975, Certificate of Award from The President of India in 1988, Certificate of Merit and Cash Award from SITRA for the Outstanding work done in the field of Energy Conservation Studies in Textile Mills in 1989, UNDP Fellowship Award in 1993, Shri Kanaiyalal Motilal Award for the Best Research Paper (Two Times) in 2000 and 2005, PCRA "National Award for Excellence" for Exemplary work in Energy Conservation for the year 1999-2000, Cash Award in 2003 from Indo German Energy Programme, Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India, New Delhi, Hari Om Ashram Award and Gold Medal from ATIRA Foundation, Ahmedabad in 2003, Outstanding Mechanical Engineer Award from Institution of Engineers (India) for the year 2008 and HabasitIakoka Research Award in 2010.

He has published 104 research papers in various National / International Conferences/ Journals. He has 13 Indian patents and two International (US) Patents to his credit. His field of interest are energy conservation, design, quality, production of mechanical and mechatronic systems.

P.Radhika received BE degree from the Department of Electronics and Communication Engineering in SNS College of Technology (Anna University) Coimbatore, India in 2009 and ME degree from the Department of Mechatronics in Karpagam College of Engineering (Anna University) Coimbatore , India with a CGPA of 9.03 in 2011.

She is currently working as an Assistant Professor in the Department of Mechatronics with PPG Institute of Technology (Anna University), Coimbatore, India. She has published 5 papers in International Journals and 6 papers in International and National Conferences. Her research interests include Robotics, Communication Systems and Mechatronics.