

Rescue Robot

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Abstract— Fire safety and terrorism are the major issues in our society. Rescue Robot is a robot/machine made for rescue operations in fire disaster, terror attacks such as bomb plant diffusing, etc. situations. The robot is fully fire proof hence can go directly inside fire zone and extinguish fire more effectively than other tools available now. The robot is equipped with tools such as a robotic arm, fire extinguisher, camera, etc. Human operator controls the robot with a GUI application and performs desired rescue operations also robot can be made automatic to perform specific tasks.

Keywords: Fire Safety, Terrorism, Robotic Arm, Fire Extinguisher, Camera, Graphical User Interface (GUI) Application

I. INTRODUCTION

Robotics is in great demand in today's world because of its usefulness in case of emergency. Robotics is the emerging solution to protect human lives and their wealth and surroundings. The aim here is to design a rescue robot using embedded system. RESCUE ROBOT is used to guard human lives, wealth and surroundings from the fire accidents as well as from terror attacks. RESCUE ROBOT is a multi-purpose fire fighting robot.

In this project, control of robotic unit is from remote and also we are able to get the videos from the robot for the purpose of surveillance. And the user PC, mobile will have video and also we are able to control the robotic movement and also camera movement and robotic arm movement in vertical and horizontal direction. DC motors are being used for the movement of various robotic parts and robot wheels. Raspberry pi is used for video processing and sending the processed video to the user pc/ control system wirelessly. All other components such as fire sensors, relays and other sensors, etc. components are interfaced with Raspberry-Pi.

II. TYPES OF EXISTING SYSTEMS

A. Rescue Robot

Tokyo Fire Department deploys a remote-control machine for rescues. A pair of manipulators is attached to the robot, which are controlled with a master-slave system. The manipulators and their control system are not original for this robot, but were developed for maintenance of power transmission lines basically. The robot moves with a pair of crawlers. The manipulators and crawlers are driven hydraulically. The robot has a retractable bed for rescuing victims. Air is supplied to the space where the bed is retracted. Furthermore, the robot has a radio communication means to allow the operator to talk to the victim and assess his or her state. The operation board is movable, and the robot and operation board are carried by truck. The robot is large and heavy, and so is useful in large, open spaces, but cannot easily be used in a complicated room.[1]

B. Humanoid Robots Rescuing Humans and Extinguishing Fires for Cooperative Fire Security System using HARMS

The humanoid portion of the Cooperative Fire Security System using HARMS(Human Agent Robot Machine Sensors)(CFS2H) system was completed using two Dynamic Anthropomorphic Robot with Intelligence-Open Platform (DARwIn-OP) humanoid robots. The DARwIn-OP is a small, humanoid robot with dynamic motion capabilities. Each DARwIn-OP has a built-in Ubuntu Linux operating system and has a built-in camera. DARwIn-OP is pre-programmed with some basic movements, a walking tuner and visual processing that can locate and identify colour. Further the DARwIn-OP robots are used as Human Rescue Robot and Fire Suppression Robot. These robots are small in size hence can be usable in small scale applications.[2]

C. Autonomous Fire Fighting Robot with Multisensory Fire Detection Using PID Controller

Tawfiqur Rakib and M. A. Rashid Sarkar developed an autonomous fire fighter robot which is constructed by locally available fire resistant and water-proof materials and performs on an Arduino based fire detection and extinguishment algorithm. The robot is also fabricated so that it can save itself from fire by keeping safe distance from the source. The robot has multisensory fire detection system for accuracy in fire detection. The Fire Fighting Robot is effective enough to fight against fire on a small scale.[3]

D. A Design of Fire fighting and Supervising Self-sufficient Robots

P. Shanmuga Prabha and N. Shivaanivarsha made A Self-ruling robot which can charge by itself, could be done without constituting fire fighters at threat. The robot rebuilds behaviours as fire fighters by exploiting robot equip in demand. Self-governing robot contains PIC 16F877A microcontroller, dc motors, RF transceivers, Fire sensors. Using of two kinds robots gives more energetic way than a sole robot. Self-sufficient robots find fire with the reinforcement of fire detector and detect it. The robot has been established to procedure in the direction area with respect to the fire expanse. The room can be identified by using IR sensor in the robot. While gathering the entire signal about the fire exposure, the robot display fire is detected. After that it starts surveying to the area in fire and extinguishes it.[5]

E. Fire-Fighting Robot

Jayanth Suresh made a Fire-Fighting Robot using Four-wheeled differential drive robot, flame sensors, ultrasonic sensors and Arduino IDE, an autonomous was designed to detect fires, extinguish and avoid obstacles. The scope of the project in the industrial sector is vast, especially in the fire department. The main operation of the robot is to detect and extinguish the fire source with the input from the flame sensors and extinguishing flames with CO₂. By using three

sensors, a general direction of flame can be computed by the data read from each sensor. The fire-fighting robot is built upon an obstacle avoidance robot.[6]

III. PROPOSED SYSTEM

The proposed system is made for rescue operations in fire disasters, terror attacks, etc. emergency situations. The robot is fully loaded with all the required equipment for the operations that includes fire extinguishing, rescuing victims, bomb diffusing, etc. The robot is built with raspberry pi-3 as the CPU to control all the operations. The raspberry pi-3 is having a Linux based operating system called Raspbian-jessie. The robot is controlled by a Human operator with the help of GUI application to perform required tasks.

The second part of the system is a fire sensor with multisensory fire sensing algorithm. This system is built with an Arduino-Uno with all the sensors interfaced with it. To detect fire for the fire safety purpose this sensory system can be installed in any area as per the requirement. The system is always on and detecting the fire in the installed area, as soon as fire is detected by the system it gives signal by ringing a buzzer also sends a signal to the security person.

IV. LITERATURE SURVEY

- 1) "Present Status and Problem of FIRE fighting ROBOT", they have considered and examined fire fighting and rescue robot from two points of views 'size and weight' and 'cause and performance'. Considering the result, they proposed five important elements to develop useful and affordable prize robot for fire department to deploy the robot. It make possible to save and rescue much more lives.
- 2) "Humanoid Robot Rescuing Humans and Extinguishing Fire for Cooperative Fire Security System using HARMS", in this paper the cooperative fire security system using HARMS that takes locates and extinguishes a fire and rescue human being using the human, agent, robot, machine, sensors (HARMS) protocol. This paper introduces humanoid robots capable of moving towards an extinguishing a fire and rescuing any humans from hazardous situation.
- 3) "Design and Fabrication of an Autonomous Fire Fighting Robot with Multi-sensor Fire Detection Using PID Controller", this paper proposes a fire fighting robot if counterfeit with locally available material and some test are done to observe the effectiveness at different situation. An Arduino based simple algorithm is used for detection of fire and measurement of distance from fire source while the robot is on its way to extinguish fire.
- 4) "A Design of Fire-fighting and Supervising Self-sufficient Robots", in this paper the rescue robot automation are specific description of implementation which can strangely increase potential. There is a special requirement for rescue robot in field which secures the human. The fire fighting and self-sufficient robot well execute the task and work of fire fighting in a simulated house fire.
- 5) "Fire-Fighting Robot", this paper proposed the aim of fire fighting robot to design a robot capable of detecting and conquering the fire by designing and implementing

an autonomous robot capable of detecting and extinguishing flames, disasters can be avoided with minimum risk of human life. In this research they demonstrate an autonomous robot capable of detecting flames indoors and negotiate towards the flame to extinguish it with the help of carbon dioxide.

V. SYSTEM DEVELOPMENT

A. Hardware Development:

The hardware part of robot consist of two main parts structural and electronics implementation which includes Robotic chassis, Robotic arm, wheel assembly and fire sensors interfacing with Arduino Uno, motors and camera interfacing with Raspberry-Pi respectively which form a complete hardware of robot.

1) Structural Development

a) Robotic Chassis

The Robotic Chassis is made with aluminium frame and covered with tin which makes it hard and stable to hold the parts of robot. The aluminium and tin makes robot versatile as these are light in weight as compared to steel. Robotic chassis has all parts connected to it such as Robotic arm, wheel assembly, the extinguisher cylinder and the entire electrical component required to drive the robot.

b) Robotic Arm

In hardware part there is a Robotic arm. A Robotic arm is a type of mechanical arm with similar function to a human arm. The base of arm has a rotation of 270 degree, Elbow rotation of 90 degree and a clamp to pick the objects.

c) Wheel Assembly

The wheel assembly of robot consist of three wheels at either side of robot, arranged in the manner so that at any critical condition or surrounding the robot will not stop its movement. The wheels are arranged such that it can overtake the stones on the ground and many more function. The alignment of wheel assembly is so accurate that it can move in accurate direction where the target is mentioned. The wheels are made by the gears and all the wheels are interconnected using a metal belt rotating over it which makes functioning of wheels easier to overtake the obstacles.

2) Electronic Development

Electronics parts of robot consist of two sections dc motors and camera interfacing with Raspberry pi and Temperature, flame, smoke sensors interfacing with Arduino UNO.

a) DC Motors and camera interfacing with R-Pi

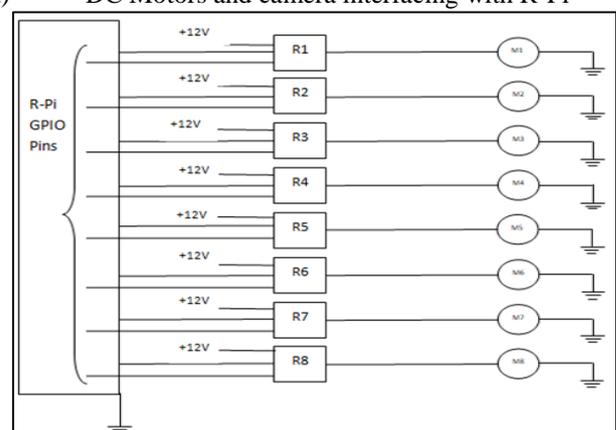


Fig. 1: DC Motors Interfacing with R-Pi using Relays

The motors of Robot are controlled via Raspberry-Pi through relays. The GPIO pins of R-Pi are connected to relay which is an electromagnetic switch. Through programming in R-Pi the Robot is controlled wireless using GUI application.

An USB webcam is connected to Raspberry-Pi with USB port.

b) Flame, Smoke and Temperature Sensors Using Arduino UNO

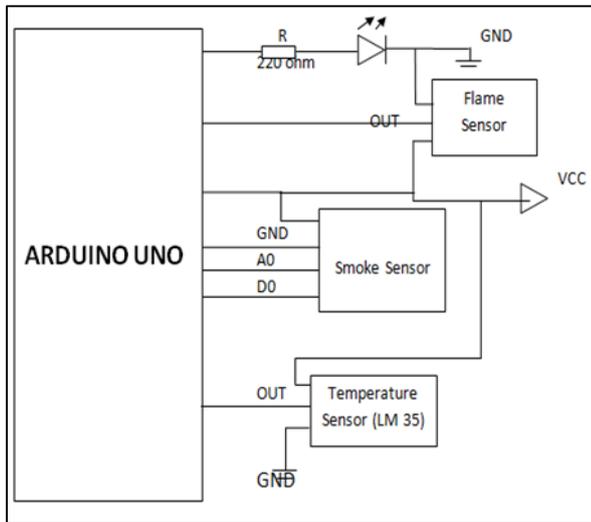


Fig. 2: Fire sensors Interfacing with Arduino-UNO

Temperature, smoke and flame sensors are interfaced with Arduino UNO which is placed in remote area and sends signal in the form of sound via buzzer and then the robot is send in that remote area from which the signal is coming by controlling the robot with GUI application to perform desired operations.

B. Software Development:- The GUI application is made for all the controls of robot.

1) First Screen of GUI

The first screen of GUI interface holds the general information of the robot.

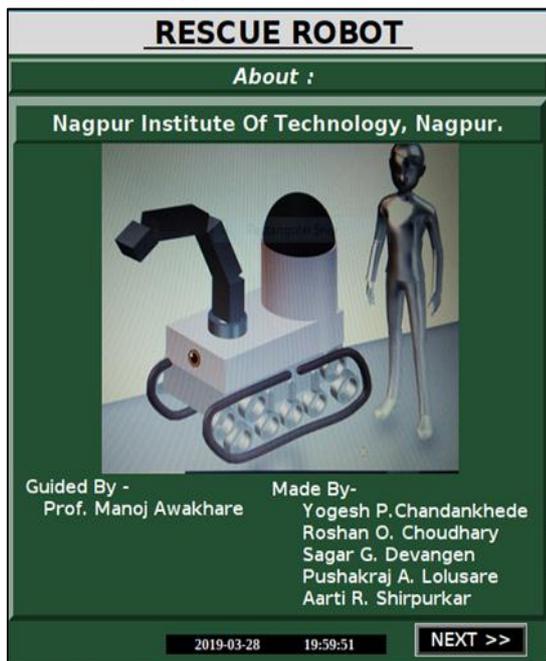


Fig. 3: First Screen of GUI

This screen is used for graphical control element consisting of a window containing an image. This screen usually appears while program is launching.

2) Second Screen of GUI

The second screen displays the login page of GUI where we have to enter the login ID and password to enter into the controlling page of robot.



Fig. 4: Second Screen of GUI

3) Third Screen of GUI

The third screen of GUI is the controlling section of robot. The upper half section displays the live video from the camera mounted on the robot and the lower half contains the buttons which functions to control the robot. The operator controls the robot by using this window to perform desired rescue operations.



Fig. 5: Third Screen of GUI

VI. IMPLEMENTATION

In emergency situation the operator can operate the robot with the help of GUI application and perform the desired rescue operation. The robotic arm will help in rescuing and will make path for rescue operation. To work robot the signal should be come from the remote area that is flame, smoke and increase in temperature should be detected by the sensors and send sound signals to the robot operator and performs desired functions.

VII. FUTURE SCOPE

The robot can be made automatic by using Artificial Intelligence and Machine Learning algorithms along with the GPS system. The robot can be made of any size and with many different types of desired tools as per the application area.

- It can be used for high security at highly inflammable places.
- he robot can be installed in public places, high rise buildings, etc. places for security purpose.
- The robot can be used by armed forces for rescue operations and other activities such as bomb diffusion/disposing, anti-terrorist activities etc.

VIII. OBJECTIVE

- The main objective of the project is to develop highly reliable security system for the safety human beings. This system will help to detect fire and send information to the monitoring system.
- To make an effective machine i.e. Robot to fight in fire hazardous situation.
- Save life of people and wealth from the Fire tragedies.
- Take action in rescue operations during terror attacks.

IX. CONCLUSION

The main goal for making RESCUE ROBOT is that it must sense fire and extinguish it with wireless control and with indirect involvement of fireman, rescue human lives and give live video footage of fire catch place to controller. The remote fire sensor detects fire with temperature, flame and smoke sensors and gives signal by ringing buzzer. The robot is operated manually with GUI application and performs desired rescue operations to rescue people and extinguish fire.

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