PC Controlled Fire Fighting Robot

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ABSTRACT—
This paper gives an abstract of fire fighting robot, an open source fire fight robot software and hardware. ht robot, This paper discusses implementation of the robot using raw materials and equipping it with IR sensing Aid, robot is controlled by wireless frequencies using Bluetooth . This robot is different than other types of robots that almost have same size and design,. The efficiency of the robot has been noted up to (95%) as average for overall actions in both operating modes the automated mode and the manual mode. Also during the tests it was clear that even with the simple control program, the automated mode is better than manual mode during operation

Keywords- firefighting robot, 3 axis fire hose, modifying camera to a TIC, heat detection mat lab program, preview video in mat lab.

INTRODUCTION

In general, a robot is a mechanical or virtual intelligent agent or any operated machine that can perform tasks auto-matically or with guidance and replaces human effort, typically. In practice a robot is usually an electromechanical ma-chine that is guided by computer and electronic program-ming. Robots can be autonomous, semiautonomous or re- motely controlled. The word robot first appeared in a play by the Czech writer Karel Capek in 1920. Robots may or may not resemble and perform functions like human beings. But they are often designed to perform tasks repeatedly and in an efficient manner [1]. Nowadays, robots do a lot of different tasks in many fields and the number of jobs entrusted to ro-bots is growing steadily [2]. Recently, it has sometimes been impossible for firefighting personnel to access the site of a fire, even as the fire causes tremendous property damage and loss of human life, due to high temperatures or the presence of explosive materials or the fire smoke hazard in tunnel fires. In such environments, fire-fighting robots can be useful for extinguishing a fire. Firefighting robots are special robots, which as special fire-fighting equipment can replace firefighters near the scene to fight fire and rescue effectively and carry out reconnaissance missions of the fire.[3] This paper studies and implements the method to build a mobile robot with human remote con-troll system in order to help a remote operator who is located far away from the firefighting robot. The mobile robot sends information of fire scene to remote terminal wirelessly in real time; remote terminal receives fire information which will be processed by the mangers computer using image processing programs to compiling the incoming data to use-full information to decide the proper strategy to fight the fire and controlling the mobile robot.

Design Goals

It is unnecessary for firefighters to expose themselves under the dangerous Condition. The motivation of this research is to improve the situation of fire location for the firemen. Therefore the objective of this research illustrated in points below □ □ Building a mobile robot with 3 degree of freedom hose arm one Cartesian and two rotational for the spray hose that is controlled from remote by fire specialist. □ □ This FFR should be able to access

the various areas and step on some obstacles which require specific design for the mechanism of moving including climbing stairs, among many designs for such robots mechanism the proper decision was to going on the tank chain design since it's more suitable with our requirements.

- As the requirements of fire station, the FFR should have a detecting system that helps in drawing a map for the separation of the fire for the firemen, the infra red waves of the objects in scene could be captured through a wireless IR camera which will broadcasting alive images to a remote computer to be calculated mathematically to thermal im-ages.
- A multifunction radio transmitter and receiver are needed to allow the fireman specialist to control the various actions that is required to react properly to the fire using the hose to extinguish it.
- The remote communication system is connected to a remote computer to control the robot and processing the incoming data.
- An automated control system embedded in the GUI control program in the remote computer is required to assist the firemen to detect and locate the hottest spots of the fire depending on image processing techniques.

With the help of such robot the fire men work will be easier and effective regardless the main reason which will make it more safety for them keeping them outside the zone of dangerous ring.

.Manipulator Design and Mechanism

Time to accomplish any mission for any robot depends on the robot capability and its degrees of freedom, many FFRs had no manipulators to guide the extinguisher hose to the direction of fire, they are depending on relocate the direction of the robot itself towards the fire, where the extinguishing hose is fixed in front of the FFR. To avoid this obstacle decision made to give the robot some degrees of freedom by adding an extinguisher manipulator to control the space around the FFR instead of relocate the FFR each time. And since tries made to minimize the robot load which cannot be done unless the consisting parts minimized, and that's mean minimizing the degrees of freedom. After discussing the demands of Kirkuk city fire department clear idea get to mind, that the manipulator should consist of 3 degrees of freedom, two rotational and one Cartesian motion

Electrical Component Design

Using a combination of both relays and transistors a de-scription of the control circuit for the four DC motors could be found, that each two of them are synchronized to same di-rection, and has capability of controlling these motors to maneuver the fire fight robot in the four directions. Commercially available Remote Control (R/C) units use small microcontrollers in the transmitter and receiver to send, receive and interpret data sent via radio frequency (RF). The receiver box has a PCB (printed circuit board) which comprises the receiving unit and a small servo motor controller. From the present-day internet to the old-fashioned radio and black & white television, communication systems form the backbone of many commonly used applications. The re-quirements of a communications system vary based on their application. Some constraints that can factor into the design of a communication system include:

☐ ☐ Cost
☐ Power requirements
☐ Reliability
☐ Range of communication needed
☐ Speed / Data Rate
☐ Conformance with Standards

These and other factors mean that the elements of a communication system can differ greatly from one system to another. For instance, a garage door opener or remote key-less entry on an automobile will need transfer speeds that are barely a fraction of what is required by optical fibers that support the internet infrastructure.

Communication systems can be broadly classified as analog or digital based on the nature of the message being transmitted. Again, depending on the application, either an analog or digital system might be the preferred way to communicate. Even within digital communication systems, for example, the implementation of the transmitter and receiver can vary tremendously. [6] First kind of RF controller's choose had a good transmit-tance range but later found to be not fit with the FFR DC motors due to the EMI emitted by the motors that lead to malfunction in the controllers since it depends on 300 MHz as a working frequency. The highest ratio of EMI for the motors is at the frequency around 300 MHz

Experimental Test Result
The test process include testing the robot using both modes for the same condition and later recording the time needed to extinguish the candles torch, the time needed to initialize the data been processed and later compare both records from the automated mode and the manual mode. The test been divided to three kind first one include one torch and the second include two torches and the third one include three torches. For each case the test repeated three times and data been recorded. The results showed that:

☐ It takes about (10-21) seconds to execute in auto-mated mode. And It takes about (27-32) seconds to execute in manual mode.

☐ It takes about (15-35) seconds to initialize in au-tomated mode. And It takes about (25-42) seconds to initialize in manual mode.

☐ It takes about (25-57) seconds as total time in au-tomated mode. And It takes about (52-71) seconds as total time in manual mode.

Now by comparing both modes according to how fast the reach to center of the fire in figure (10) it seems that the ma-nual mode takes the largest portion for all the three cases and the automated mode needs fewer attempts to achieve its goal in extinguishing the fire spots.

CONCLUSION
Fact that both the automated and manual mode is required in the fire fight robot is that the fire fight robot is the first version and the control system is not perfect, for this reason some times the operator need to make decision in some situ-ations, in other word the human supervision is required, the difference between both modes are listed below: The automated mode:
☐ Detecting the largest heat spot by image processing
☐ Detection process could be effected during processing
☐ Faster in dealing withsituation
☐ Controlling the movement is automated

While the manual mode:
☐ Detecting the largest heat source depend on opera-tor skill
☐ The operation under operator control
☐ Takes more time

☐☐ Directing the arm takes the operator attention and his timeto achieve best result for the fire fight robot both the auto-mated mode and manual mode should be used during any extinguishing mission in order to minimize time required and losses in lives and materials.

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