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WEB CONTROLLED FIRE EXTINGUISHING ROBOT

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Abstract— Nowadays the amount of effort put forth by the officials of the fire department manually can be eased. They can perform safer operations with the help of a mobile robot. In this paper, a Web Controlled Fire Extinguishing Robot is proposed taking into account the difficulties faced by the fire fighters to reduce the level of impact caused by a small flame which would have lead to a disastrous situation. A mobile mechanical device is used to extinguish fire at the desired location. The robot consists of a Pi camera mounted at the front interfaced to the Raspberry Pi. By using this application, commands are sent to the robot through a Wi-Fi module. The robot moves in all possible directions by using the buttons present on the web console interface. A water motor pump is used to extinguish the fire at the site by careful observation done by the Pi camera. The video streaming done by the robot enables the fire fighter to remotely operate from a distance at the time of emergencies. The high risk involved undertaking of fire fighters can now be accomplished safely and effectively without consuming any additional time.

Keywords— Raspberry Pi, Fire Fighter, Video Streaming, Motor Pump, Console Interface.

I. INTRODUCTION

Internet of things is a system in which all the physical items and places in the world are connected via wireless and wired internet connections. The number of devices that can be connected through IoT varies in huge amount. With the merit

of using an internet connection, the information can be communicated both ways. The Information about their device's surroundings are shared to the systems or end users. IP based networks also have good performance and reliability needed for making connections. The system that is used to move around, sense and perform a task is a robot. They are mainly used to work in risky situations which involves damage; life and property of the living. Fixed robots are not preferred usually as they have limited space and cannot be run on a mobile platform. In order to extinguish fire in various hospitals, industries etc. these mobile robots come in handy to put off the fire at the required site. The need for more number of fire fighters can now be decreased with the use of a fire extinguishing robot. The electronic circuits of computer components can be combined onto a single integrated chip called as a system on chip. It uses less power, space and is reliable as it consists of both hardware and software. One such example of a system on chip is the Raspberry Pi. It has an in-built Bluetooth and Wi-Fi support to communicate over the internet. It is credit sized and can be plugged to a monitor, TV. The implemented fire extinguishing robot which is powered by a battery makes necessary connections and uses a web console interface to navigate the robot in forward, backward, left and right directions. It maintains a constant speed and has a Pi camera mounted on it to live stream the front view of the robot. The web console also contains a button to run the water motor pump when the fire is seen on the display of it. The fire is then handled effectively at that particular location by operating the robot using wireless technology of the Raspberry Pi.



II. LITERATURE SURVEY

Most of the papers that have been proposed implemented a fire extinguishing robot which was controlled by Arduino via in-built Wi-Fi network support.

From [1], it has been studied that the robot uses an android application with Arduino as the microcontroller and user commands such a turn right, turn left, backward and forward were sent to the microcontroller which translated into robotic movements. It used ultrasonic sensors to stop at distance of less than 15cm.

[2], discusses about the usage of flame sensors to sense the fire and trigger the water pump to extinguish fire. The microcontroller Arduino was used. Security is provided by the robot at home, buildings, factory, and laboratory.

In [3], it has been studied about the utility of SSH connectivity and how the robot can be controlled over long separations.

The study [4] proposed of using a web camera over the USB port for real time monitoring of the robotic movements. It used the node JS structure to manage web socket protocol and engines.

However the implementations and methods used in these papers have their own limitations. The energy of the robot could go down after a long time usage. The use of sensors alone would not be a good choice as they could face problems in processing the environment for sensing the fire. This could further lead to a wide spread fire disaster. The surrounding environment at that particular time can be a great problem. After analyzing the work done by different authors, to overcome such a situation, a system has been developed which proposes a Pi camera which is used to interface to the Raspberry Pi's Camera Serial Interface instead of interfacing the web camera to a USB port. It uses a fire extinguishing robot that does not need any additional hardware which would have been needed if a microcontroller was used. Hence the cost required for implementing is also less comparatively. The real time monitoring of the robot comes in handy as the user can know what situation the robot is in. The motor pump is used to pump the water to extinguish water. Robot is controlled wirelessly from a remote location and the user can interact irrespective of the distance between the robot and the user.

Table I shows the comparison of different methodologies used by various authors in referenced papers. It also shows the advantages and disadvantages based on the study done from these referenced papers.

Table I: Comparison of Methodologies

Ref.No.	Paper Title and Author	Advantages and Disadvantages	Methodology	Result
[1]	Fire Extinguisher Robot using ultrasonic sensor and wifi network controlled with Android Smart phone by B.Siregar, H.A.Purba, S.E Fendi, F. Fahmi	Advantages: Multiple User Operation Disadvantages: Controlling the water pump's direction	Android application and ultrasonic.	The robot was tested for how good it runs and the maximum distance for the robot control was known as well.
[2]	An Arduino based firefighting robot by Vynzarali R. Amenodun, Hussain P. Lawanza, Mojahid C Marada, Margie Rose	Advantages: Good Accuracy Disadvantages: Low Adaptability	Flame, detection using Arduino Gas	Flame sensors, Gas sensors are used to sense and trigger the water pump to extinguish fire.
[3]	Web Controlled Surveillance Robot by Devijyoti Ghosh, Shreyas Bandari, Vedant Shirali	Advantages: Portable, 24 hours surveillance Disadvantages: Holding the camera still.	SSH Connectivity	Utility SSH, robot can be controlled over long separations.
[4]	Open Source Mobile Robot with Raspberry Pi by E. Kurvikulahi and R. Guler	Advantages: No additional control hardware Disadvantages: Low video quality	Node JS structure was used to manage web socket protocol and engines.	Internet controlled open source mobile robot design and application has been created which can be used for real time monitoring using web camera over USB Port.

III. WORKING PRINCIPLE

The fire Extinguishing robot is controlled by the mini-computer Raspberry Pi 0 W. The whole system is powered by batteries. It has a Pi camera to the front of the robot. Two Dc motors are used to run the robot which drive the power required from the L293D motor driver. This helps in the navigation of the robot in all possible directions which is left, right, front and back. An R385 motor pump is used to pump the water when needed. The system also consists of a relay and a voltage regulator which maintain constant output voltage in order to not overheat the hardware components present in the system. The communication between the robot and the user takes place through the in-built wireless technology. A web console displays the buttons needed to perform robotic task and displays the video streaming done by the Pi camera at the remote location. The user through the video streaming checks for the fire and then pumps on the motor water using the web console button to extinguish the fire.

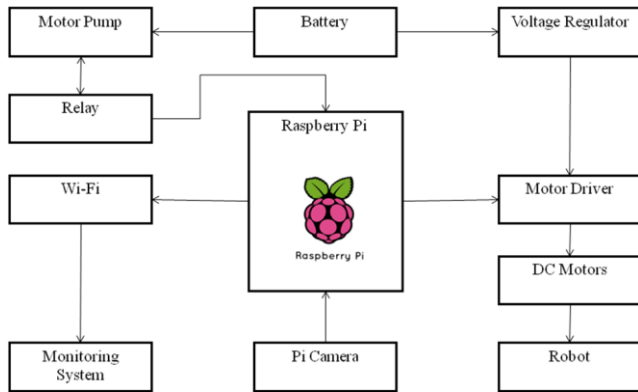


Fig 1: Block diagram

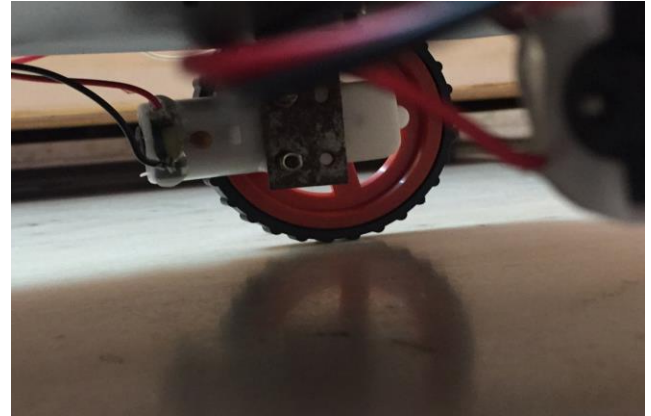


Fig 3: DC Motor

Fig 1 shows the interfacing of various hardware components.

IV. EXPERIMENT AND RESULT

Implementation of a Web Controlled Fire Extinguishing Robot is done by testing individual components. Results have shown that the robot was able to move in all the directions. When experiment was conducted by lighting a fire it has been observed that the robot was able to extinguish fire efficiently. The entire experiment is controlled through a web console, through which a robot could be navigated in the appropriate direction as well as stream the entire scenario on the console.

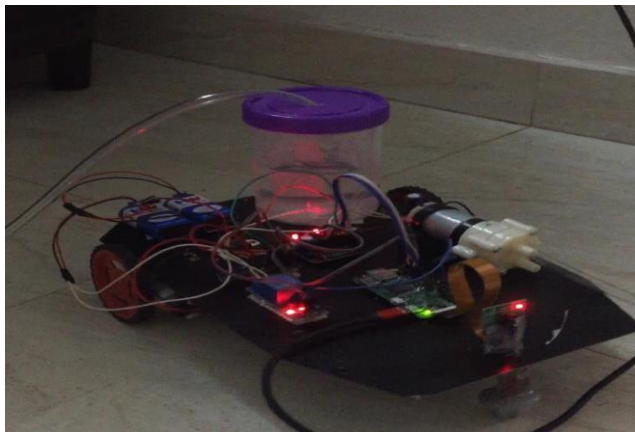


Fig 2: Web Controlled Fire Extinguishing Robot

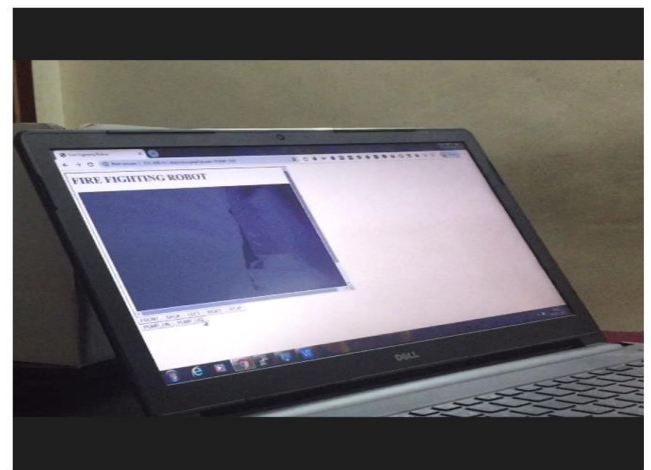


Fig 4: Web Console Interface

In Fig 2, all the hardware components interfaced on the robot are shown. Fig 3, shows the DC motors required to move the robot. Fig 4, displays a web console interface through which the user commands the robot to perform tasks.

V. FUTURE WORK

Further, the system can be designed to enable robot to advance to a more robust system which is fully autonomous. The advanced technologies like Artificial Intelligence, Image Processing etc. can be implemented for detecting fire from the video streaming. The robot could use various environmental sensors to perform accordingly and notify the user about the fire location. A Robot which, when once started by user, navigates, searches and extinguishes fire on its own without any assistance or input from the user can be implemented.



VI. CONCLUSION

The paper presents the design and the implementation of a fire fighting robot, controlled by Raspberry Pi, that moves towards the fire location and pumps water to extinguish the fire. It shows how to interface various components to the Raspberry Pi. The system can potentially be useful to accompany fire fighters and prevent an outbreak from a remote location. A Pi camera has been used instead of a web camera making the task easier. The aim is to reduce the effect of fire accidents and the loss and damage it causes which starts with a small flame. Manual effort has been reduced to a great extent. A reliable and economical system has been implemented.

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