

Using Android Phone to Control Raspberry Pi Robot for Live Streaming and 3D Image Processing

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Abstract: Nowadays, industrialization and technologies have increased with economic growth and development which in turn has increased the living standards of people. In every corner of the world we have industries which make use of the resources to fulfill our needs. This pollutes the environment as well as human health by releasing smoke, toxic, undesirable, and flammable gases into the air. The proposed model can be used for detecting leakages of the harmful gases by monitoring containers, pipes or tanks in the area where humans cannot enter using raspberry-pi robot. This robot will be sent to the areas where monitoring is required. In raspberry-pi, static ip is configured. Robot is connected to android phone through wifi so that it is not limited to certain range but will be able to move up to wider range. The android phone is used for controlling the robot movements like moving left, right, forward, backward or capturing and recording. The command from phone is given to the robot which will then capture the images and process them into 3D images. Recording option is also present in the phone so that it can record the live events happening in that area. By typing this ip in the browser, user will be able to see the login page. New user can register themselves to view the live streaming whenever required while admin will be able to view the live streaming as well as previous videos and 3D processed images which will be sent to the website automatically from the phone. After being aware of the leakages, necessary action could be taken to avoid the problems in future.

1. Introduction

With the increase in chemical industries and technologies day-by-day living standards of the people is also increasing rapidly. It has resulted into variety of serious problems like undesirable release of the gases, chemical pollutants, etc. These gases have not only destroyed environment but has also affected human beings by causing health problems

such as asthma, bronchitis, emphysema, and possibly cancer. Carbon monoxide is an odorless, colorless gas that can kill living beings who breathe it. Release of the toxic gases could be dangerous as it can lead to explosion or can start a fire. Therefore, detecting gases is essential for the safety of living beings working in an environment.

We have heard about Gas Authority of India Limited (GAIL) pipeline tragedy in Andhra Pradesh. The pipeline had corroded due to condensate and water that came along with the natural gas from an Oil and Natural Gas Corp (ONGC) field. Water corroded bottom of the pipeline, causing pores in the underground pipeline. Gas was being transported at high pressure and it leaked along with flammable condensate to the surface on the night of June 26/27. Overcast weather lead to a cloud of gas being formed even as condensate sprayed on the ground. A spark on June 27 led to condensate and cloud of gas catching fire with a loud explosion [1]. If proper monitoring of pipeline had been done then this incident would not have happened. There are many sections or narrow spaces where humans cannot enter to monitor pipes or tanks in that location.

So, in order to deal with this problem and ensure safe environment there is a need for detecting and monitoring leakage in such areas. Therefore, raspberry-pi robot is sent to such areas for monitoring and leakage detection which is controlled by an android phone. The command from phone is sent to robot which is connected using static ip for movements. The robot and phone is connected to wifi to provide wider range. On clicking a button the robot will capture images and process them to make 3D images and store it. Phone will be having command for image capturing as well as live streaming. These videos and images are sent on static ip from where one can view images. Only administrator will be able to view images and live streaming along with previous videos. The website can be opened on any computer using static ip which was configured on raspberry-pi. To provide security

on website, login page is provided so that only authentic users can view the images and videos..

2. Literature Survey

Low-cost smart security camera using Raspberry pi and OpenCV performs 24/7 monitoring. With the help of this system real time monitoring can be done to provide footage again illegal activities. It can also provide surveillance during night time. This system provides real time monitoring, surveillance footage thus provides authority evidence against illegal activities. This paper will be useful to know low cost of the system and it also gave us ideas about which tools we can use to effectively make our system work [2]. Another system we studied is capable of performing live streaming and controlling the robot. This IP based system makes it affordable and accessible from anywhere within a particular network. This provides better picture quality and also provides scalability and flexibility. Thus can provide surveillance in a local network which can be home, office, shopping centers, and prisons or for that matter anywhere which needs to have a momentary surveillance or a continuous one just plug it in the network and the robot is good to go [3].

Producing octree models of 3D solid objects from their silhouettes obtained in a sequence of images. A 3D model of the object can be constructed by intersecting conic volumes obtained from a series of images which are captured during surveillance. This method can be used to get detailed information about leakages or any distortion present. These 3D models will give better understanding about object and problems related to that. Knowing it more in detail will help us solving issues related to that. Hierarchical octree structures are used to constitute and to process 3D volume data efficiently A long sequence of images has to be processed with a view to produce an precise model of a complicated entity or several clustered objects. The solid modeling system for computer vision as described in this paper is a part of a much larger project which attempts to unify the representation and operate of 3D data obtained from many various sources-medical, seismic, depth range, vision-and synthetic 3D data produced by computer-assisted design systems[4].

3. Existing System

India is actively participating in development and evolution in science and technology so as to deliver the requirements demanded by citizens. As a result of that factories, chemical plants and petroleum industries are growing gradually. Due to this catastrophe in augmentation at such places is observed. Leakage of hazardous chemical substances, explosion and ignition of fuels and

release of flammable liquid and gases are some examples of catastrophe experienced in industries. With the proper monitoring system this kind of accidents can be evaded. There are many surveillance systems modeled for monitoring. Let us see a few of them along with their drawbacks:

4. Smart Security Camera using Raspberry pi and OpenCV is a system constructed for surveillance and it is designed to be used inside a warehouse facility. This system is devised using a low cost security camera with night vision capability using raspberry pi. This system is having the ability of human detection and smoke detection that can be used to avoid potential crimes and potential fire. The researchers evolved a light-footed surveillance camera that has the potential of identifying the condition of the scene that is being monitored and also give notification or alarm as the event occurs. OpenCV is free software that can be useful for optimizing code for basic image processing infrastructure. This system also provides security during night time as it is having potential to provide night vision. Night vision capability is attained by simply taking off infra-red (IR) filter from an ordinary webcam and thus can be used for night vision sensing with the help of IR Light Emitting Diode illuminator. The system can also detect motion of an object using background subtraction algorithm. Once moving entity is diagnosed, the system can classify it as human or smoke. If something like that is detected, the system appries or notify in the form of alarm and email to indicate fire or unauthorized person [2].

Multi-environment robot for surveillance and live streaming is developed to assemble real time surveillance system possible within a local network. The live streaming is accomplished using mjpeg streamer and the server-client model is build using java. As ip based installation provide access from anywhere and hence are preferred over analogue system. The analogue systems are easy to use even for people who are not much into using such stuffs and also cost effective as compare to the IP based system. IP based systems offer superior picture quality and they are also favorable when it comes to scalability and flexibility. But Ip based system need some pre understanding and knowledge about networking and people having low budget are unable to take advantage of IP based system as these systems are too expensive than the analog ones. This raspberry pi controlled robot is incorporated by a server-client model. This client server model is constructed on java and thus can work on any systems such as windows, Mac or Linux. This system is made on java for obvious reason to achieve Platform independency. This entire model is connected to local network and anyone available in

that particular local network can control it from anywhere. This local network can be home, office or shopping mall wherever we require to ensure safety can be modelled. The live streaming is done by MJPG streamer. it will be installed in the pi and then initializing the camera module[3].

The method is of generating octree models of 3D solid entity from their silhouettes acquired in a sequence of images. To illustrate 3D and to process 3D volume data in well-organized manner hierarchical octree structures are being used. The individual objects volumes are labeled as connectivity-labeling algorithm, and vectors of surface-normal are added to their surface volume elements. This model also includes volume of the workspace which is still not observed in any image. This paper gives the outline of a modern process for creating 3D models of solid objects from multiple views. Once a final 3D model is constructed from a sequence of images, it is further improved by labeling contiguous solid volumes as individual objects, adding surface-normal vectors to the modeled entity, and mapping image intensities on the surfaces of the modeled objects. These supplementary characteristics will help in object recognition and in physical object manipulation in future. . The solid modeling system for computer vision as described in this paper is a part of a much larger project which attempts to unify the representation and operate of empirical 3D data obtained from many diverse sources-medical, seismic, depth range, vision-and synthetic 3D data produced by computer-assisted design systems[4].

4. Proposed System

We proposed a model to build a real time live streaming and 3D image processing monitoring system using Raspberry pi with installed wifi connectivity. This will reduce the number of cases of accidents in the surveillance area as well as will provide a great deal of logistics information from the 3D images of defined area provided by the user and constantly monitor it over handy android phone.

4.1. Working of the System

The major phases in the application will be the

4.1.1. Monitoring Phase: In monitoring phase the pi will record the video of the location in real time as shown in the block diagram Fig 1. The command for capturing video is given through the android phone to the pi. This command will be transferred to the pi using wifi. This command will decide when to start and stop the video capturing. While the video is being captured the Pi-Bot will move, thereby allowing us to get video of a wider area. The pi camera is being used which will give a very good quality of picture in the video.

4.1.2. 3D image Capturing and Processing Phase: In 3D image capturing & processing phase the pi will capture images for different angles. The images captured using different angles will allow us to build an approximate 3D model of the objects. We can also calculate approximate height and width of the objects using this information. The images will be captured using the pi camera which will give a better quality of image. The commands to capture images will be given by the android phone. This command will be transferred to the pi using wifi as shown in the block diagram Fig 1. The captured images will again be transferred back to the android phone.

5. System Requirements

5.1. Smartphone Requirements

- The system will work on all smart phones running Android version 3.0 or higher.
- A persistent data connection. (Wi-Fi)
- A smart-phone with a least 600 MHz Processor
- An XHDPI resolution screen is preferable.

5.2. Raspberry pi Requirements

- The Raspberry pi will be running on NOOBS (New Out Of the Box Software).Raspbian operating systems are currently included in NOOBS.
- Memory - 512MB RAM
- Raspberry-pi camera module
- Raspberry-pi MJPG streamer

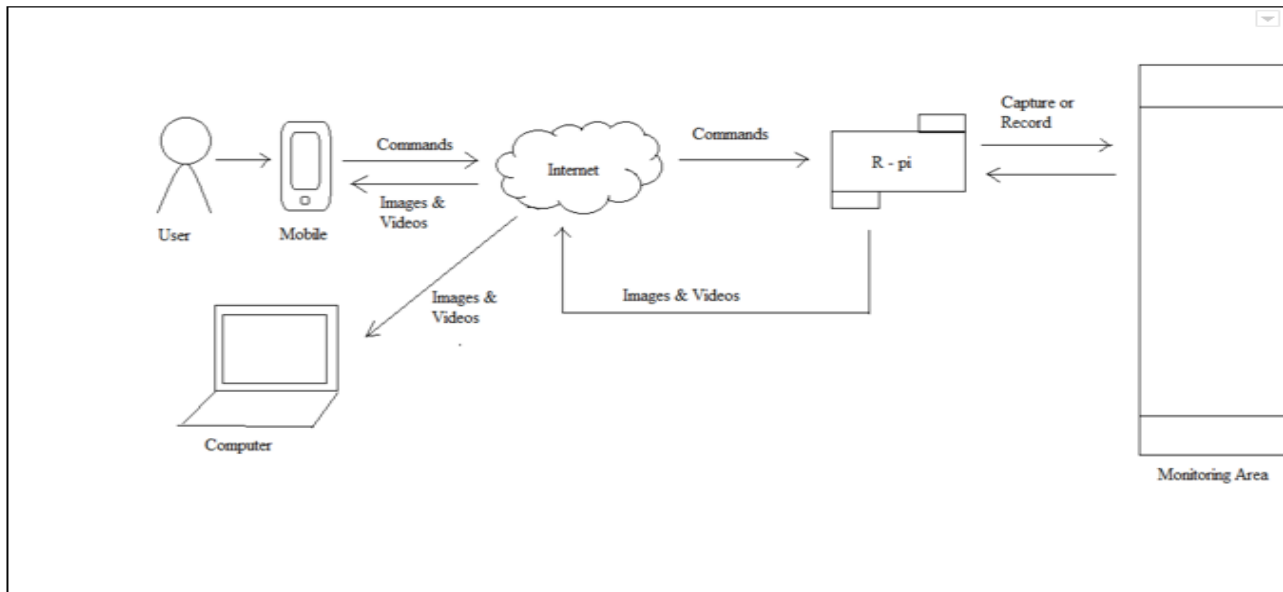


Fig 1: Block Diagram of Proposed System

6. Implementation

The connection of Raspberry pi with the motor driver is done as shown in the Fig: 2. The GPIO pins of the raspberry pi are connected to the input pins of the motor shield. The output pins of the motor shield are connected to the motors 1 & 2 respectively. A portable charger of 2amp current is connected to the motor shield while another outlet of the portable charger is connected to raspberry pi. Once the connections are done properly the raspberry pi is ready to boot up.

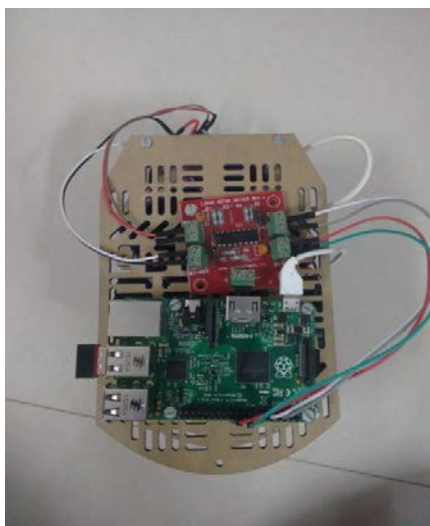


Fig: 2

A Python program is written for controlling the motors where in the GPIO pins will give out the output from the raspberry pi to the motor shield based upon the option selected on the app by the user.

A simple navigation app has being developed to control the bot movement. Here the app is connected to the Raspberry Pi over the wifi. As a button is pressed the app will sent a packet over the wifi to the raspberry pi. Which when accepted by the Raspberry pi will acknowledge the python program written in the raspberry pi for controlling the motor to send proper inputs to motor shield.

The camera module is installed properly into its port. Now the camera needs to be enabled in raspberry pi settings. Once this is done Raspberry pi will reboot itself. Now for the Live Streaming of videos Mjpg streamer is installed and configured. After the configuration steps are done just view the live streaming in the app as well as the website.

The website has been developed to allow large number of people to experience the live streaming irrespective of their location. Here admin rights are given to authenticate the visibility of critical information by only authentic users.

7. Results

Here Fig: 3 and Fig 4 shows the working of the raspberry pi robot in the real world.

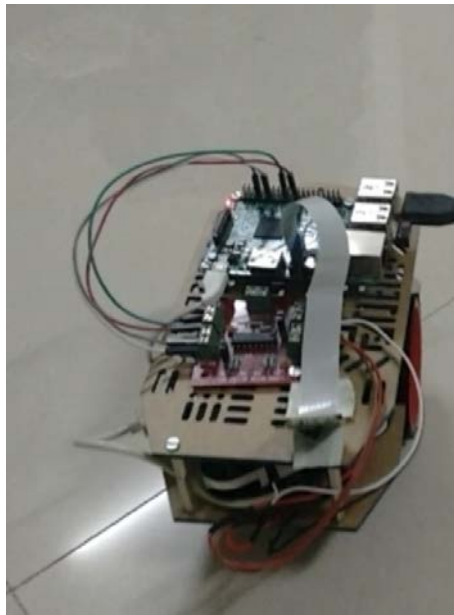


Fig: 3



Fig: 5

An Android App is made to control raspberry pi bot remotely.

Once android phone gets connected to raspberry pi, it will show the images captured by raspberry pi camera module as shown in Fig: 6 raspberry pi bot is connected to android through wifi.



Fig: 4

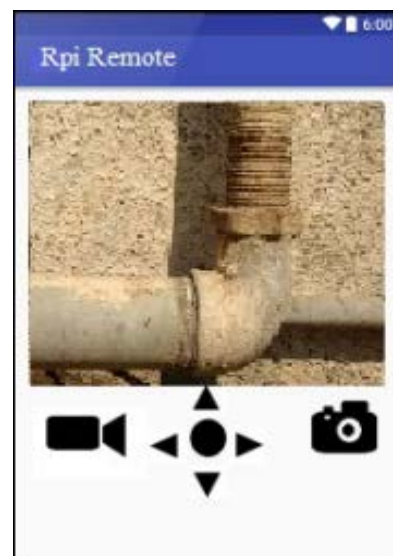


Fig: 6

As shown in Fig: 5 we have to enter ip address of raspberry pi which is being assigned statically and then click on CONNECT to get connected with raspberry pi bot.

To control the movement of pi bot navigation keys are used to move forward, backward and turn left , right as shown in Fig: 7



Fig: 7

Along with images, videos can also be recorded and can be live streamed on phone as shown Fig: 8 as well as on the website.



Fig: 8

Go to the browser and type ip address which is configured in raspberry-pi in the address bar. The login page will appear as shown in Fig: 9. This page will have username and password in which only authenticated user can login.

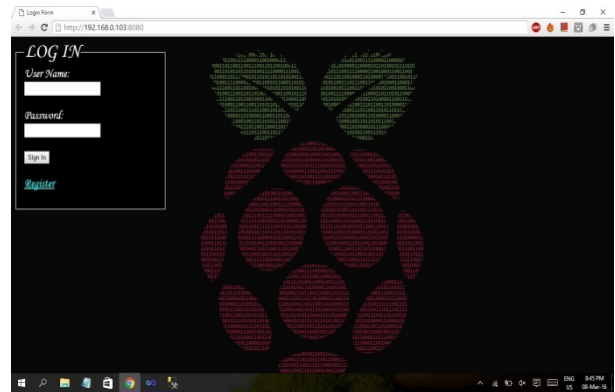


Fig: 9

For new user there is 'REGISTER'. On clicking this, user will be forwarded to new page as shown in Fig: 10. In this page user can create new account where he/she will enter the information like name, address, etc. If he/she want to reset all the information there is RESET button present at the bottom of the form. After user will click on REGISTER button, the information will be stored in the database and he/she will be redirected again to login page.



Fig: 10

After entering correct username and password he/she will be redirected to the page as shown in Fig: 11. This page will show live streaming and image of the monitoring area.

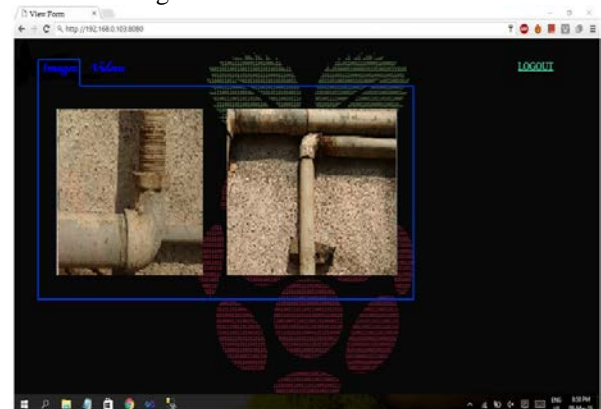


Fig: 11

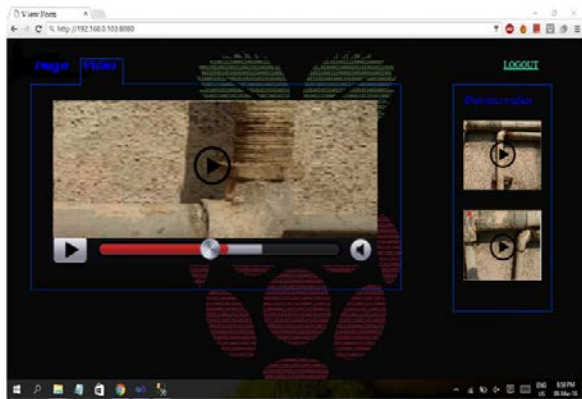


Fig. 12

If admin login he will be redirected to the page as shown in Fig. 12. This page will also show live streaming and images of the monitoring area but in addition to this he will be able to view previous stored videos and images and also 3D processed image can be viewed on clicking the image.

8. Conclusion

The system thus aims at easing monitoring and surveillance through the android application for smart phone users by providing them with a cheaper alternative. This application will be of great advantage to users looking for monitoring small and narrow places which are unreachable by users. It will help in surveillance of any location and providing 3D images of the same. Monitoring the location will reduce the rate of accidents. Since the cost of the system will be low it will be affordable to the common man. Also with its additional features mentioned above, it will be a complete application for any user who wishes to monitor area from any location.

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