International Journal of E-Health and Medical Communications
Volume 12 • Issue 5 • September-October 2021

Improving Performance During Camera Surveillance by Integration of Edge Detection in IoT System

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ABSTRACT

This paper is proposing an IoT-based camera surveillance system. The objective of research is to detect suspicious activities by camera automatically and take decision by comparing current frame to previous frame. Major motivation behind research work is to enhance the performance of IoT-based system by integration of edge detection mechanism. Research is making use of numerous cameras, canny edge detection-based compression module, picture database, picture comparator. Canny edge detection has been used to minimize size of graphical content to enhancing the performance system. Simulation of output of this work is made in MATLAB simulation tool. Moreover, MATLAB has been used to give comparative analysis among IoT-based camera surveillance system and traditional system. Such system requires less space, and it takes less time to inform regarding any suspicious activities.

KEYWORDS

Camera Surveillance, Canny Edge Detection, Cloud Server, IoT, MATLAB, NET Platform

1. INTRODUCTION

At present, IOT (Gubbi et al, 2013) is a hot cake for tech-savvy people and its applications are continuously in demand. It became possible because the dependency on Internet is increasing day-by-day.

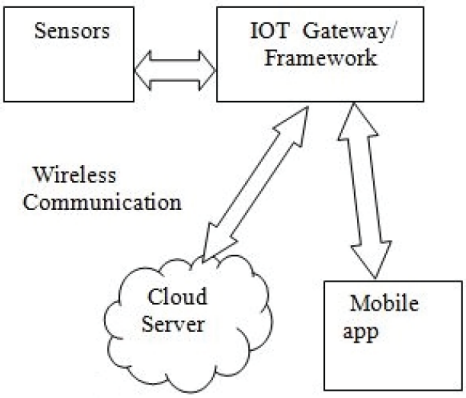
IoT (Iqbal et al, 2017) saves a lot of time. It happens because with the help of this technology user manages their household appliances without any delay. In addition to the home automation system, the internet of things also works on an industrial automation system. In the initial system, the household devices are managed by the consumer at some distance.

The layout of the internet of things is arranged in Figure 1. In this layout working of the internet of things is explained. IoT system faces a lot of challenges (Tiwari & Maurya, 2017) during implementation. In the second system equipment which is installed in a manufacturing unit is managed from a distance. When the internet of things (Miraz et al, 2015) is used, chances of failure are very less.

It happens because different types of protection devices such as fire alarm and theft alert system are employed. Working of IoT based security system (Alem et al, 2016) is shown below:

DOI: 10.4018/IJEHMC.20210901.oa6

Figure 1. IoT Architecture (Gubbi et al, 2013)



The compression of data could be performed using an edge detection mechanism (Kumar et al, 2014). However, there have been several research work that focused on edge detection using Fuzzy logic (Suryakant, 2012).

When the technology of the internet of things is used for Home Automation it provides several benefits which are explained below:

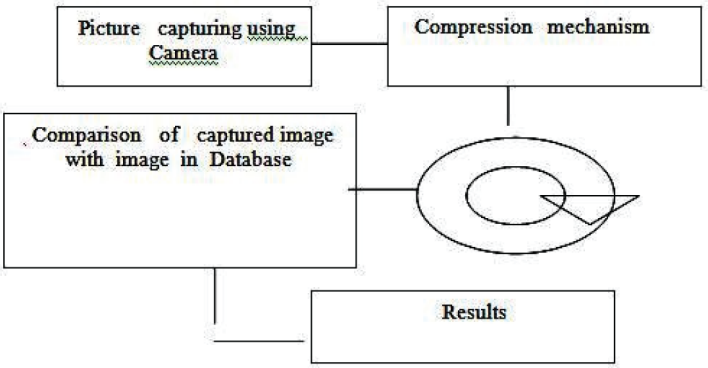
1.1 Excellent Functioning of Equipment

The user interference is not a requirement in houses where the internet of things equipment has been used. This equipment provides a very high level of performance. The equipment which provides programming and controlling facilities to its user is called IOT (Gubbi et al, 2013) gadgets.

1.2 Consume Less Time

When internet of things devices (Lam et al, 2016) are applied the consumer does not carry out the same task on regular basis. Due to this less time is consumed. Consumer obtained high-level performance because the transmission is done through the device to the device. Due to this, consumers obtained accurate output.

Figure 2. Working of an IOT based Security System



1.3 Economization of Money

With the use of the internet of things (Dharampal et al, 2015) devices, energy, and resources are used in a very perfect way. This technology can be adopted in a very efficient way if the devices are kept under observation.

1.4 Improve Lifestyle

Our lifestyle has improved due to the use of AI-based applications. The devices which are made based on artificial intelligence increase the level of our satisfaction. It will make our life more convenient. As a result, it is sure that it will improve our lifestyle. Many researchers have focused on the security and privacy feature (Zhou et al, 2018) of IoT. At many locations, NFV enabled IoT Architecture (Miladinovic & Schefer-Wenzl, 2018) has been used. IoT is suffering from challenges and issues from an Indian perspective (Yadav et al, 2018).

1.5 Neat Atmosphere

At present, based on sun position and the direction of blowing wind it is possible to manage the opening & closing of windows. At this point, a program is available for this management work. It also reduces air pollution because we can easily observe the discharges of carbon from various sources. With the help of this technology, it is possible to identify forest fires. Based on load requirement a smart device (Yadav et al, 2018) also reduces energy consumption.

1.6 Health Monitoring

It is quite easy to recognize health-related problems when the equipment which is made based on internet of things technology has been utilized. This equipment provides great support in the favor of doctors when used in hospitals. In addition to this, this equipment also helps old people and handicapped citizens.

Several IoT applications (Bali et al, 2018) have been studied in present researches. It is observed that the IoT real-time specification (Haikun et al, 2018) is found challenging. This research is making use of IoT with surveillance cameras (Alexandrie et al, 2017) to minimize crime.

2. EDGE DETECTION

In the present world, where the way of living life is very modern, edge detection of the image is highly required. It is mostly required in forensic and the army. Therefore, absolute knowledge of this detection algorithm is compulsory. Edge detection played a great role in image processing. When the intensity value or pixel value of the image changes sharply then this change in pixel value is easily recognized by edge detection. In the present time, its various types are ready for use. Within the algorithms of image processing, a great role is played by edge detection. It has many applications like deformation of the image, identification of the sample, partition of the image, and its removal. Most of the information towards the image is provided by the edge. Therefore a great role is played by edge detection in the method of image processing. It provides the dimension of a picture is supplied by it. It will identify the image in the form of an object in the company of its identified edges. Several unusual edges are provided when this technique is used for an image. When these unusual edges are integrated, it will design the summary of the object. With the help of this technology accurate edges are identified. It is a very important property of this technique. In addition to this, it will also recognize the right direction of the object in the picture. The total amount of storage space required for the accumulation of image edges is less in comparison to the whole image. These image edges include information regarding object dimension and its direction. The definition of an edge is provided from a different point of view. Out of these different points of view, one is “It changes either the

brightness or the color of an image ". In normal circumstances, in an image edges are represented in different forms. These forms are:

1. Step edge
2. Ramp edge
3. Roof edge
4. Line edge

Different researchers invented different edge detection algorithm. But based on the used order of derivative they are divided into two types. Out of these two types, one is Gradient-Based and the other is Laplacian Based.

Canny edge detector- In the middle of edge detection algorithms that are available at present, the Canny edge detection algorithm is used on regular basis for the last few years. The algorithm of image processing is considered for the last thirty years and it is used for the accumulation of image information. In the image of a scene, various types of information are present like the size, color, and direction of objects. In the primary step, the object is separated from its surrounding. After that edges are identified to design the summary of the object. Due to this reason, from a computer and image processing point of view, his technique is very valuable. "Canny Edge Detection Algorithm" used two-level for each image. To achieve improved edge mapping, the technology of a Canny edge detector is used in all parts of an image. But, in this process, some false edges are determined in a smooth area and some appropriate edges remain unidentified. This problem is resolved by a block-level canny edge detector. It supplied improve efficiency at each block of the image

3. CANNY EDGE DETECTION ALGORITHM

It works in the form of the operator which is used for (Alem et al, 2016) edge detection. It uses an algorithmic program that has several steps. In images, it will detect a large number of edges. The Discovery of the best possible edge detection algorithm is the only plan of this method. An edge detector is considered in the form of the best detector when it will perform good detection. The genuine edges which are located inside an image are made clear by the algorithm. In situations where marked edges are almost similar to the edge of a real image, it is considered that its location is good. It gives a response in a single attempt because the noise of the image does not create artificial edges. Due to this, a given edge in the image is only visible once, and whenever possible.

To provide these requirements in written form mathematics of modifications is used by this detector. This method detects the assignment by which a certain method becomes optimized. This algorithm is considered best in comparison to other edge detection algorithms. The compulsory standards about canny edge detection are described below:

1. **Highest Precision:** It is very essential that no edge will remain undetected and there should be no response for non-edge.
2. **High-quality tracking:** The space detected by the detector in the middle of edge pixels and the actual edge is the least.
3. **Exclusive Response:** It means that a given edge in the image is only visible once, and whenever possible. The algorithm mainly has five steps in it.

The algorithm works on a different level:

1. **Smoothing:** It is the primary level in which an image is made blur to eliminate noise. For this purpose, median filtering is applied.

2. **Finding gradients:** The edges should be made clear at points where the progression of the image has vast dimensions.
3. **Minimum repression:** It means that limited maxima are considered in the form of edges.
4. **Double thresholding:** Applied for determination of appropriate edges
5. **Edge detection by output lag:** Ultimate edges are identified when the edges which are not related to a certain edge has been removed completely.

3.1. Social Applications of Edge Detection

By considering how this detection technique has been used in Macao society the popularity of this detection technique in public demand is displayed.

- **License Plate Detection:** In the present world, cars are used everywhere. Therefore it is certain that intelligent traffic control will become a trend in the future. Therefore, we will discuss here how this detection technique is used for the identification of the license plate. The technology of license plate detection is commonly applied at the gates of the toll plaza, in car park areas. It has been found, this technology will provide some useful significance if some modification is done. 1.Sample image gray scaling and QDPA operator edge detection. 2Detection of hidden information in medical images. A comparison is made between phase-based detection methods and usual edge detection methods. From this comparison, it has been found that the basic difference in the middle of these methods is that in addition to edges of the object, some furtive information of test object is also detected which cannot be identified by conventional methods. Conventional methods are not able to identify this information because the color of these details and their immediate area are almost similar.

3.2. Advantages of Canny Edge Detector

1. Canny edge detection is very flexible.
2. It can modify itself to recognize the edges with different characteristics.
3. Gives reliable detection.
4. It is best for edge detection because it follows all the standards of edge detection and it is used in a very effective manner.

3.3. Disadvantages of Canny Edge Detector

1. If the quality of leveling is essential in the three-dimensional field it will work out slowly.
2. It is unfair in the direction of vertical and horizontal edges and in the case of revolving equilibrium it does not provide a satisfactory estimation.

4. OBJECTIVE

Objectives considered in this paper have been discussed in this section. The major objective of this work is shown below:

1. Research would review traditional Camera Surveillance Systems and study their limitations.
2. Implementing an IoT based camera surveillance system. The system would provide a security (Iqbal et al) mechanism to detect suspicious activities.
3. Using Canny Edge detection (Kumar et al, 2014) mechanism to minimize the size of graphical content to improve the performance of the security system.

4. Using Cloud (Biswas et al, 2014) Space to reduce the cost of storage.
5. Proposing a comparative analysis of the proposed system with traditional work.

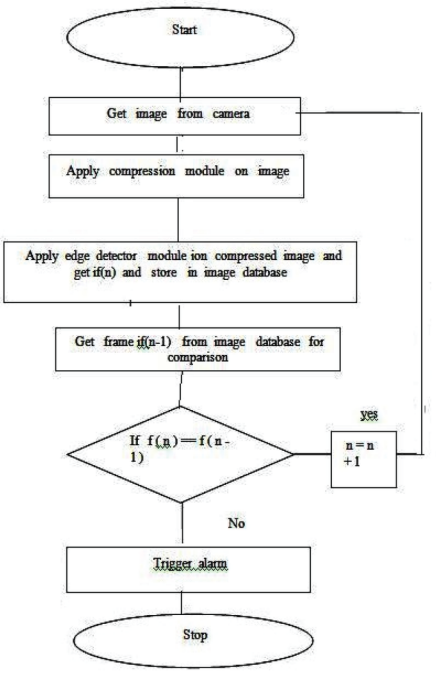
5. METHODOLOGY/TECHNOLOGY

There have been many research methodologies that are needed in the case of such research work. Various types of researches are basic research, Quantitative researches, theoretical research, Qualitative Researches. This is an Experiment Research where IoT based Camera Surveillance system has been technically proposed. In this proposed system, Numerous Cameras, Canny Edge Detection (Dharampal et al, 2015)) based compression module, Picture Database, Picture comparator is used. The simulation of the result of the proposed module is made in MATLAB. In addition to this, MATLAB has been used to provide Comparative Analysis among IoT based Camera Surveillance system (Alexandrie et al, 2017) and Existing system. To achieve objective implementation of Home automation IoT System is required to using WI-FI (ElShafee et al, 2012). There are several mechanisms to proposed a smart surveillance system (Rai et al, 2019) that should be energy efficient (Kodali et al, 2018) and should be helpful even for physically disabled people (Faroom et al, 2018). The use of interaction based sensing (Fan et al, 2014) could play a significant role in the proposed work.

6. PROPOSED MODEL

For protecting the surveillance of a camera an edge detection technique is used here.

Figure 3. Process flow of the Proposed Model



This technique is formed based on canny. For the storage of consecutive images, one by one the image records are utilized.

In this process, initially, a camera is used to click an image. After that, a Canny edge detection model is applied to this graphical substance It is done for reducing the data size. After that these frames are accumulated on the system. In the same way, whenever a frame is captured it is reconfigured and processed by the edge detection technique. In this method, a comparison is made in the middle of the latest and the previous frame. If any variance or doubtful action is detected, that means if the current frame and previous frame are different then the status is updated to records. These records are placed in a remote cloud. In addition to this, a warning device is also activated in this condition.

7. RESULTS OF IMPLEMENTATION

At this point, a system that is used for the surveillance of the camera is put into operation. In this system, the technology of the internet of things is used. For putting this system into service MATLAB & ASP.NET are used. In this research, the images are taken through the camera with the help of the MATLAB tool. After capturing, it compares a fresh image in the company of the previous image. In this way, the modification in images is noticed. In this work, a component that is used for the capturing of an image has been formed in MATLAB.

7.1 Image Capturing Components

The components which are used for capturing pictures and for saving them in jpg form is as follows:

1. The image would be read using the read command in Matlab. The image name would be Ci.jpg (Note: here I start from 1 to n);
2. The canny function would convert the picture to the edge-based version of the picture and store the result int variable;
3. The next frame would be read and again it is converted to edge version using canny function the next image would be C + 1.jpg;
4. The Comparison of the picture is made using ait_picmatch.

rrr1 represents the extent of complementary in the middle of two pictures. A signal goes in the direction connected with the web link in situations where rrr1 does not match with I.

7.2 Matlab Code to Simulate to Time

7.2.1. Comparison Between Traditional and Purposed System

The simulation of different image frames would be made here. A comparison of form n is made with the form n plus one. Comparison time and space consumed has been considered in this simulation. The time consumption during frame comparison is considered in this simulation. The image comparison time has been taken using the tic toc function. The tic function is placed before the module and toc function has been placed after the operation. As the Matlab script runs the time taken during operation is recorded in another variable. The variable is taken and stored to perform the comparison between traditional patterns where the edge detection mechanism is not applied and the proposed pattern where the edge detection mechanism has been applied. The edge-based image comparison would take lesser time as compared to the image without edge. Here below the MATLAB code is given which is used for the comparison of the proposed system with the traditional system on the base of Time Consumption.

Comparison of Time consumption in the middle of the present and future analogy system has been plotted in the Tabular and graphical form here.

In this graph, the time in second in the case of traditional work is compared to the time in second in the case of the proposed model. The following figure is showing that the proposed work (green line) is plotted below the traditional work (red line).

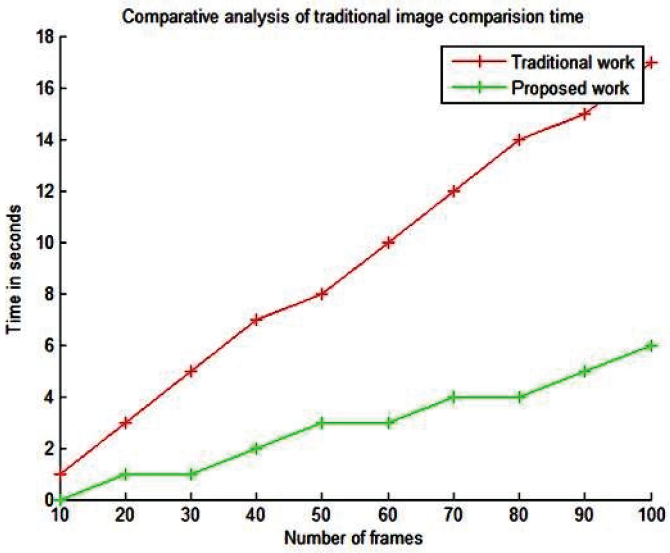
7.3 MATLAB Code to Simulate Queuing Delay Between Traditional and Proposed System

Here below the MATLAB code is given which is used for the comparison of the proposed system with the traditional system on the base of Queuing Delay. The algorithm for the process flow of plotting is shown below:

Table 1. Benchmark studies of Time consumption in the present and future analogy system

Number of Frames	Time consumed in Traditional Work (in seconds)	Time consumed in Proposed Work (in seconds)
10	1	0.1
20	3	1
30	5	1
40	7	2
50	8	2.5
60	10	2.5
70	12	4
80	14	4
90	15	5
100	17	6

Figure 4. Benchmark studies of Time consumption in the present and future analogy system



1. Clear all variables
2. set value of C=1
3. set value of tf = 0.176088
4. set value of pf = 0.061221
5. set value of counter i= i1
6. set ii = 10 and repeat up to step 11 until ii is not equal to 100
7. set x (counter) = i
8. calculate y1(counter) = tf * i + i * C
9. calculate y2 (counter) = (pf * i) + (i * C)
10. calculate counter = counter + 1;
11. calculate ii = ii + 10
12. put hold ion command on
13. sketch y1 in terms of x in red shade
14. sketch y2 in terms of x in the green shade
15. set title to " Comparative analysis of traditional queueing delay"
16. set horizontal label "Number of frames"
17. set vertical label " Time in seconds"
18. set legend as 'Traditional work ', ' Proposed work ' for indexing

Benchmark studies of Queuing Delay in the middle of present and future analogy system has been plotted here in Tabular and graphical form.

Table 2. Benchmark studies of Queuing Delay in present and future analogy system

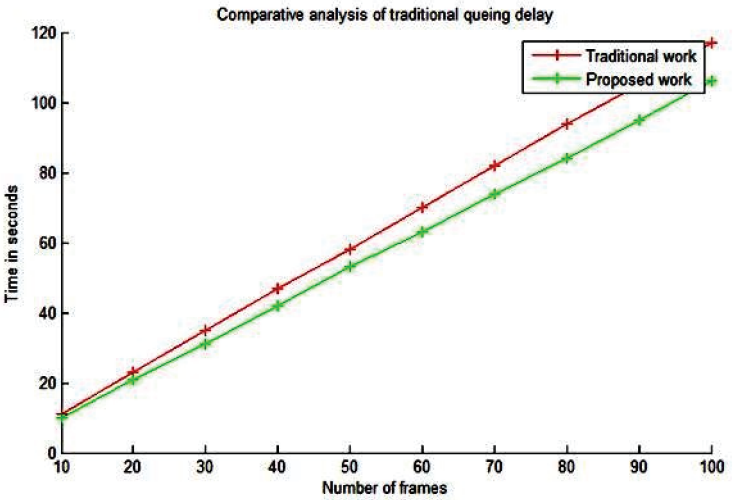
Number of Frames	Time consumed in Traditional Work (in seconds)	Time consumed in Proposed Work (in seconds)
10	10	9
20	22	20
30	36	28
40	46	40
50	58	50
60	70	60
70	80	70
80	90	80
90	100	88
100	118	106

7.4 MATLAB Code to Simulate Comparison of Frame Size Between Traditional and Proposed

Here below the MATLAB code is given which is used for the comparison of the proposed system with the traditional system on the base of Frame Size. The algorithm for plotting the size of the frame is discussed below:

1. set tf to 9

Figure 5. Benchmark studies of Queuing Delay in present and future analogy system



2. set pf to 5
3. set ii to 10 and repeat to step 7 until ii is not equal to 500
4. set x (ii) to ii
5. set y1 (ii) to tf * i i
6. set y2 (ii) to pf * i i
7. set i to i + 10
8. put a hold on command on
9. sketch y1 in terms of x in red shade.
10. sketch y2 in terms of x in green color.
11. Set title to ” Comparative analysis of traditional image size ”
12. Set horizontal label as “ Number of frames ”
13. Set vertical label “ Size in Kb ”
14. Set legend to “ Traditional work ”, “ Proposed work” for indexing

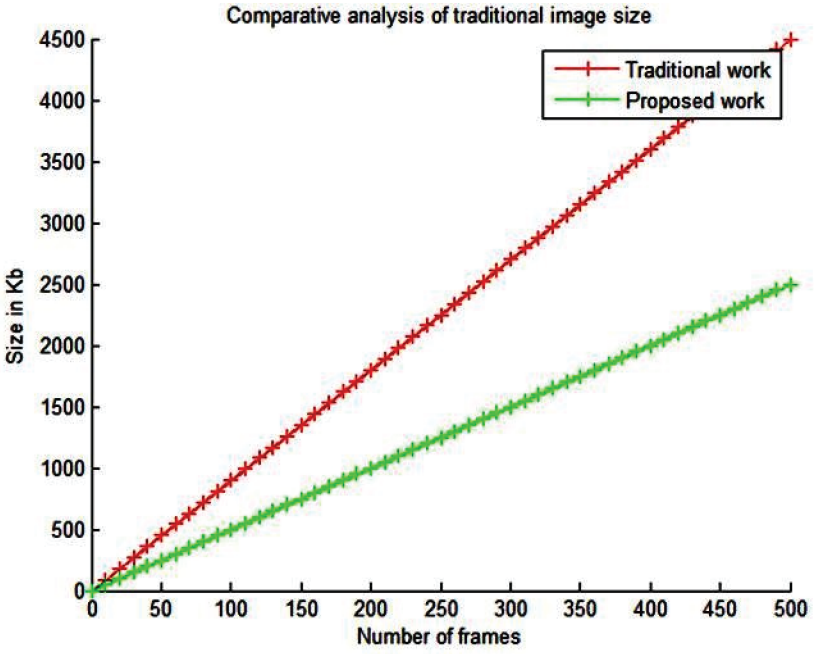
Benchmark studies of file size in the middle of present and future analogy system has been plotted here in graphical form.

In this graph, the file size in kb in the case of traditional work is compared to the file size in kb in the case of the proposed model. The following figure is showing that the proposed work (green line) is plotted below the traditional work (red line).

8. CONCLUSION

With the help of work which has been done here, the problems related to security systems are settled down. These problems are physical surveillance, insufficient storage space, and delayed notification. In this research, the observation of the camera has been made automatic and fast. In the research work which has been done here the requirement of human interference is completely removed. In addition to this, whenever a doubtful action is detected signal is transmitted at remote locations. Due to the use of the edge detection method in this work, the time required for doing frame comparison is less. In addition to this, the cost required for accumulation is also reduced. It happens because

Figure 6. Benchmark studies of file size in present and future analogy system



the captured picture is made compact and the edge of pictures is taken into account exclusively. It happens because in this system only doubtful operations are reported.

CONFLICT OF INTEREST

The authors of this paper declare no conflict of interest in this paper.

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