



## Proposed Model for Remote Maintenance of CCTV Cameras

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## ABSTRACT

A data center is a physical facility in which an organization stores its critical applications and data. In our paper, the researchers developed an Android model for surveillance CCTV system maintenance and fault identification. The descriptive analytic approach and object-oriented systems analysis and design approach were used. The Unified Modeling Language (UML) was used as a tool in analysis and design, and Java was used as a programming language to develop an Android model to maintain CCTV faults. Image freezing, incorrect time and date, and video delay were resolved. It has been developed an Android model that works on smart phones to monitor and maintain surveillance CCTV systems. This model allows users to view faults reports and fix camera faults, such as (image freezing, camera image delay, and incorrect time on the camera) in surveillance CCTV systems from anywhere that has Internet access.

**Keywords:** Maintenance, surveillance system, and CCTV maintenance.

## 1. Introduction

Surveillance means to monitor behaviors, movements, activities, and information for controlling, managing, and protecting people. CCTV cameras (Closed-circuit television) can be used as an electronic device to observe from assistance or by tracking information transmitted over the internet and phone [1]. A surveillance system monitors a predetermined environment based on received data [2]. CCTV system design, so that the system functions within the limitations of human vision and the performance of the sociotechnical system can be optimized [3]. CCTV surveillance provides a rich context for research into visual attention, search, monitoring, and detection [4]. could be advantageous in CCTV settings dealing with security [5]. The model of surveillance systems is a great enhancement of security level to the monitored area by providing important reference for the security teams to make prompt actions against threats or incidents. The widespread implementation of the surveillance cameras significantly deters criminal behavior and reduces vandalism to agency property [6].

The surveillance area does not stay the same for a long period of time. There could be illumination changes, such as the sun being blocked by clouds causing changes in brightness, or physical changes such as a dust any changes in illumination can cause false positives. Additionally, any foreground object detected for a long time without any motion (a parked car) can cause false negatives [7]. Maintenance is an action taken to retain a system in, or return a system to its designed operating condition. It extends the useful life of systems, ensures the optimum availability of installed equipment or equipment for emergency use. Maintenance is quite often very expensive and may extend the investment cost with time. Figure (1) gives a survey of the different type of maintenance activities, usually maintenance is a planned action. Preventive or scheduled maintenance begins with inspection and includes, e.g., cleaning, adjustment, lubrication at predetermined intervals, is also includes the replacement of minor components, subject to Wear, before they fail, depending on inspection. Corrective maintenance includes reactive maintenance. Unplanned maintenance is performed in an emergency situation to avoid immediately drastic failures, shut-downs or losses, or for safety reasons [8].

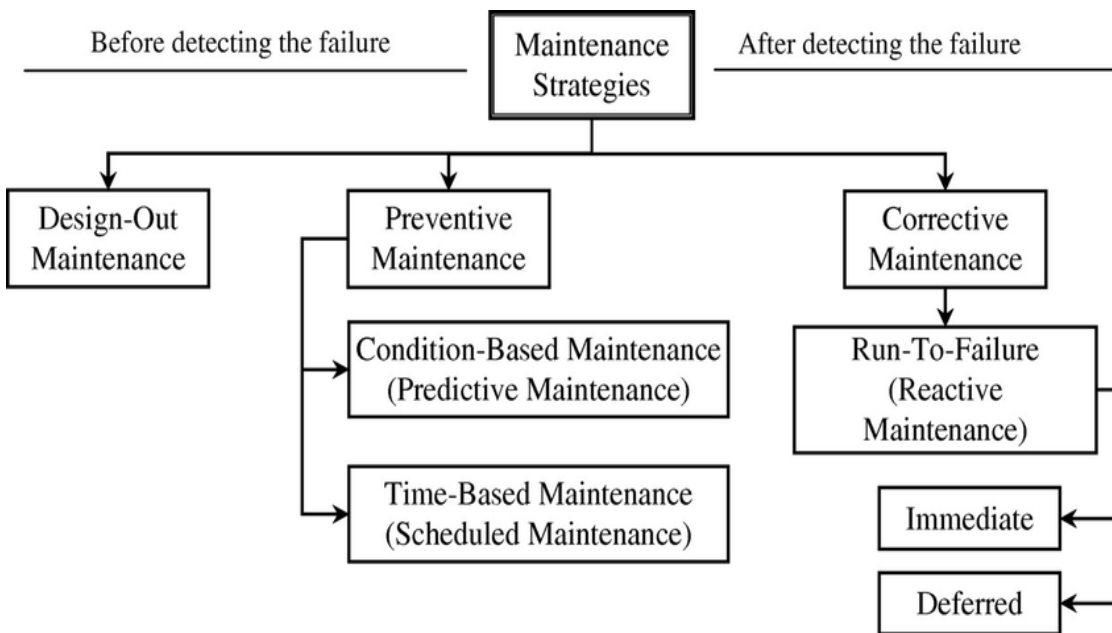


Figure 1. Type of maintenance.

In this paper, the researchers propose an Android model for maintaining surveillance cameras remotely. The model provides information about network failures (camera disconnect) or electrical failures (camera no video) or other failures via a faults report, and can be used to maintain cameras that have malfunctioned remotely. By using the model by the smart phone, the engineer or the director can know what the situation is with the surveillance cameras and malfunctions, as the simple faults (video delay, freezing images, and incorrect dates and times) can be corrected intelligently without going to the control room.

## 2. Related work

Recently, vision-based methods are used to estimate position information from square markers [9]. A system for raising and lowering the CCTV camera mounted at a high place was recently proposed. The previous works included using a computationally efficient model of background variation, a prioritized, multivalued, default logic-based framework for reasoning about the identities of individuals, and an investigation of the rate of occurrence of failures (ROCOF) of a multi-component repairable system. Chae M-U and Lee CH. [10]. They designed a system that checks the status of unmanned surveillance facilities in real time, problems like malfunctions can be detected and automatically fixed, and managers are notified by text messages when problems occur. An integrated network video server (NVR) will receive information on the operation status of the main equipment, such as video, sound, and lighting, and send real-time text messages using an SMS server.

Moon C and et al [11]. They designed a system to check the status of the unmanned monitoring facility in real time, try to recover automatically in case of a problem, and notify the administrator in case of a problem. Designed system comprises an NVR which receives and evaluates information, such as image, sound, and lighting condition, and a control device that detects and restores the state of the unmanned monitoring facility. The system proposed expected to contribute to the improvement of the economic efficiency due to the minimization of surveillance space due to the failure of the unmanned monitoring facility and the reduction of the inspection cost.

Haritaoglu I and et al [7]. used a model of background variation that is computationally efficient. they assume each pixel intensity distribution is bimodal. The background scene is then modeled by representing each pixel by three values; its minimum  $m(x)$  and maximum  $n(z)$  intensity values and the maximum intensity difference  $d(z)$ . and they described fast background scene modeling and maintenance techniques for real time visual surveillance system for tracking people in an outdoor environment. It operates on monocular grayscale video imagery, or on video imagery from an infrared camera. Shet VD and et al [12] proposed a prioritized, multivalued, default logic-based framework that allows reasoning about the identities of individuals. Then achieved by augmenting traditional appearance matching with contextual information about the environment and self-identifying traits of certain actions. This framework also encodes qualitative confidence measures for the identity decisions it takes and finally, uses this information to reason about the occurrence of certain predefined activities in video. Alsyof I and et al [13] were investigated a procedure how to assess the rate of occurrence of failure (ROCOF) of a multi-component repairable system and improve its reliability. A procedure was developed and tested on closed-circuit television dome cameras operated in an airport in the United Arab Emirates. Optimum replacement times for critical components were calculated, and then a practical preventive maintenance schema was suggested to reduce the overall cost. Moon C and et al [14] were proposed a system for raising and lowering the CCTV camera installed at a high place. The system consists of three parts. First, the driving part for controlling the motor for camera movement is designed. Second, the sensing part that detects the position of the camera and the motor current is designed. Finally, the control part processes the signal of wired/wireless remote controller and controls the system. In this paper, the researchers develop an Android model that maintains surveillance CCTV system faults related to malfunctioning cameras.

## A. Surveillance overview

The word Surveillance has been derived from the French word “sur” means “from above” and “veiller” means “to watch.” Surveillance means to monitor behaviors, movements, activities, and information for controlling, managing, and protecting people. CCTV cameras (Closed-circuit television) can be used as an electronic device to observe from assistance or by tracking information transmitted over the internet and phone. Laws in many countries have restricted their domestic government & the private use of surveillance, generally restraining it to situations where public safety is in jeopardy [15]. In the past, it has been observed that surveillance by human operators has certain limitations like high labor costs, variations in long-duration capturing, and limited multi-screen monitoring[16]. In the last few years, the video surveillance market has seen a major transformation into third generation video surveillance systems, moving to IP video from traditional analog video causing better processing power and improved compression algorithm [17]. The design of a video surveillance system requires decisions that need familiarity with the basic options and the basis behind the selection of any available choice in the market [18]. So, designing a system requires better remote access, further remarkable mix with different systems, enhanced picture quality and additionally that requires maintenance flexibility [19, 20]. Fig (2) illustrates the most common CCTV system, which consists of cameras (usually up to 16), a digital video recorder, and two monitors. The first monitor shows the overview of all connected cameras. The overview can be divided (usually into 4, 9, and 16 fields). On the second monitor, a picture from the camera that currently detected motion through a motion detection system is shown. Events are recorded digitally via a digital video recorder on HDD hard drives. The digital video recorder may have a lot of functions, such as: a sequential switcher, a video splitter, an event recording system integrated with motion detection. It is most often equipped with an Ethernet card as well, thanks to which remote handling via the Internet (the Intranet) using the TCP/IP protocol is possible [21]. based on frame differencing by comparing adjacent frames in video footage. identified areas of interest by looking for abrupt changes in the frames' contents [22].



**Figure 2. surveillance CCTV system.**

## **B. Faults**

A fault is an unpermitted deviation of at least one characteristic property (feature) of the system from the acceptable, usual standard condition.

Fault types:

- a fault in the system is independent of whether the system is in operation or not.
- a fault may not affect the correct functioning of a system.
- a fault may initiate a failure or a malfunction.
- frequently, faults are difficult to detect, especially if they are small or hidden.
- faults may develop abruptly (stepwise) or incipiently (drift wise) [23].

Potential Faults Include:

- poor lighting.
- site audio not working.
- no camera image.
- camera image distorted.
- detection triggered by foliage.
- detection triggered by overspill.
- loss of connection.

### **Most Common CCTV Problems:**

#### **A- Get Black and White Images**

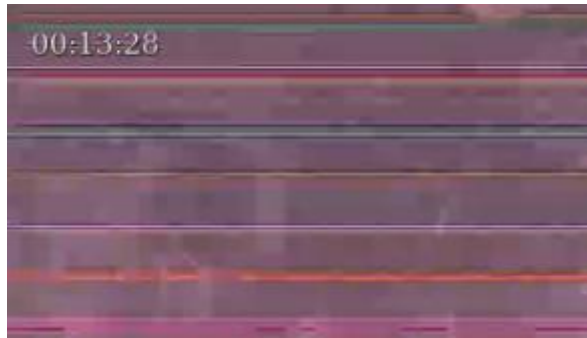
In most cases, color CCTV cameras will produce black and white footage for one of two reasons. Colors are visible to CCTV cameras only when ambient lighting is high enough. Infra-red LEDs are used to illuminate the scene in low-intensity ambient light conditions in night cameras.



**Figure 3. black and white image (24).**

## B- Horizontal Lines on CCTV Video

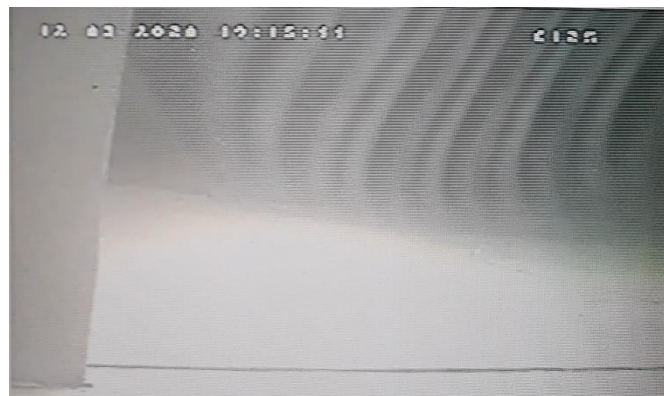
On CCTV footage, horizontal lines can make it difficult for staff to observe sensible areas for long periods of time, and they may also make it difficult for staff to distinguish fine details. There are only two common root causes of interference from ambient lighting or electrical interference. The bad news is that the latter can be tricky to diagnose.



**Figure 4. Horizontal Lines on CCTV Video.**

## C- Camera Footage is Noisy

A noisy CCTV camera is usually caused by electrical interference or RF interference. The researchers captured Image in figure (5) which illustrate noisy in camera footage.



**Figure 5. Noisy CCTV Camera Footage.**

#### D- No Video Signal

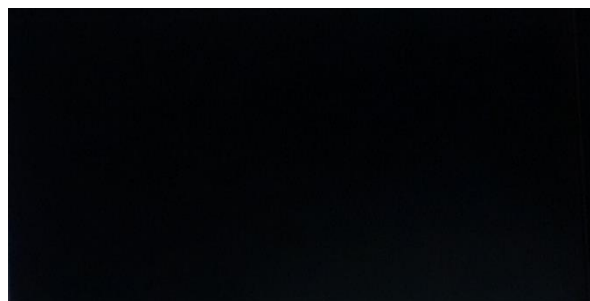
Flickering or noise are the most frustrating CCTV problems. In figure (6) The researchers captured an image form a real surveillance video system to demonstrate the (no video signal) fault.



**Figure 6. Camera without video.**

#### E- Camera Shows a Black Screen

It doesn't show any picture and nothing but a black screen. The researchers designed figure (7) to illustrate a black screen camera image.



**Figure 7. A black screen appears on the camera.**

### 3. Methodology

This study employed a descriptive analytical approach, semi-structured interviews to collect data, an object-oriented approach to system analysis and design, as well as the Unified Modeling Language (UML) as a modeling tool, and the Java programming language to develop an Android model by the Android Studio program. UML analysis and design programs have been used, including lucid chart and visual paradigm, as well as motion detectors to control movement and reduce camera recording. An interview took place in January 2019. Interviews were conducted face-to-face in the Sudani data center. The mean duration of interviews was 15 min. In the literature review, a gap was identified in understanding the barriers and enablers of implementing a maintenance surveillance system in Sudanese data centers. The research aims and objectives were derived accordingly. Based on the results of this literature review, the interview topics were open-ended, allowing participants to elaborate on areas of interest.

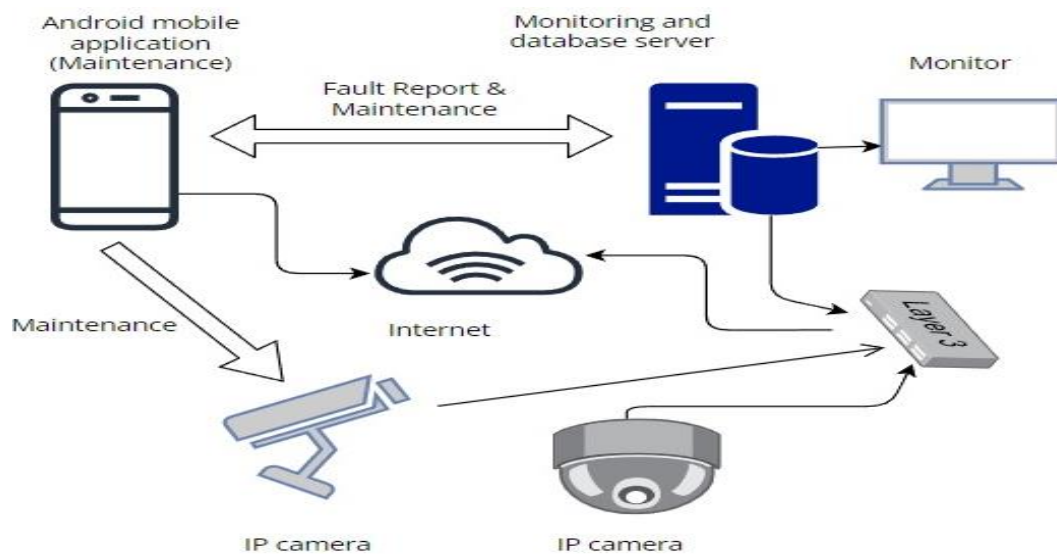
## A. PROPOSED SYSTEM

A crime is the issue with which almost every government has to deal. Personal identification by at a distance by a smart CCTV surveillance system can help the guards to catch intruders and thieves. and place visual surveillance systems at locations where the intruders usually seen, e.g., corridors, near servers' rooms, etc. The aim is to use surveillance and smart phone technology to accomplish the entire surveillance task automatically, as well as maintenance CCTV cameras and fault reports. These days, CCTV systems are using a variety of well-monitored devices. CCTV systems are using a variety of well-established methods for human detection.

## B. SYSTEM OVERVIEW

- A model of remote maintenance surveillance camera system

A remote model can identify the monitoring faults in surveillance cameras with the date and time when they occur, and maintain faults in surveillance CCTV systems, for instance when an engineer is working outside of the data center. In that case, the engineer will turn on the model. Which will maintain surveillance camera faults when fault happened. In figure (8), The researchers describe our proposed system.



**Figure 8. Propose System Architecture.**

- **Video Surveillance**

In this system IP (Internet protocol) camera is used as camera. Digital video Camera is connected with network and server is connected to local network with the Internet. Videos are transferred from IP camera to the network. Images with high resolution can be transferred with the 30fps speed. an android model connected with camera and data base server by internet connection. The researchers have captured the figure (9) below to illustrate IP camera.



Figure 9. ZTE IP camera.

• System Flow

System flow shows overall behavior of system. System flow clearly shows how system will behave from input state to output state. This shows all functionality and how system will change its state from one state to another on correct input to system.

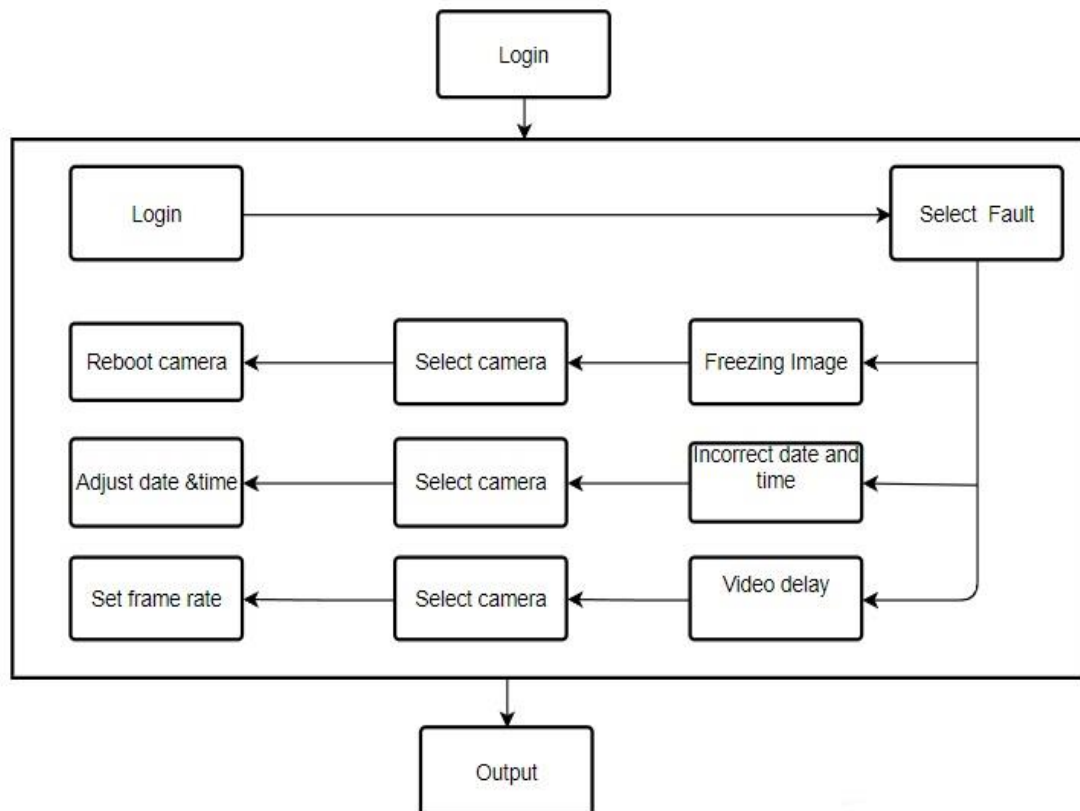


Figure 10. System's process flow.

#### 4. Results and Discussion

##### 1- Freezing camera image

In order to solve the freezing of the camera image (the camera gives a hang image, but it is still working), The researchers had to perform a reboot, which allowed the camera to start again and work normally without making a trip to the site. Figure (11) shows how to solve this problem by model and figure (12) shows how to solve it using a logarithm.

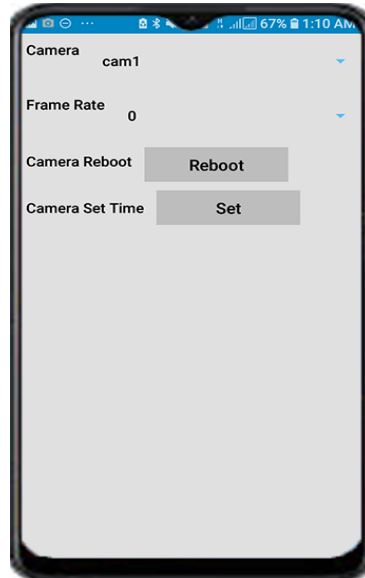


Figure 11. Reboot camera 1.

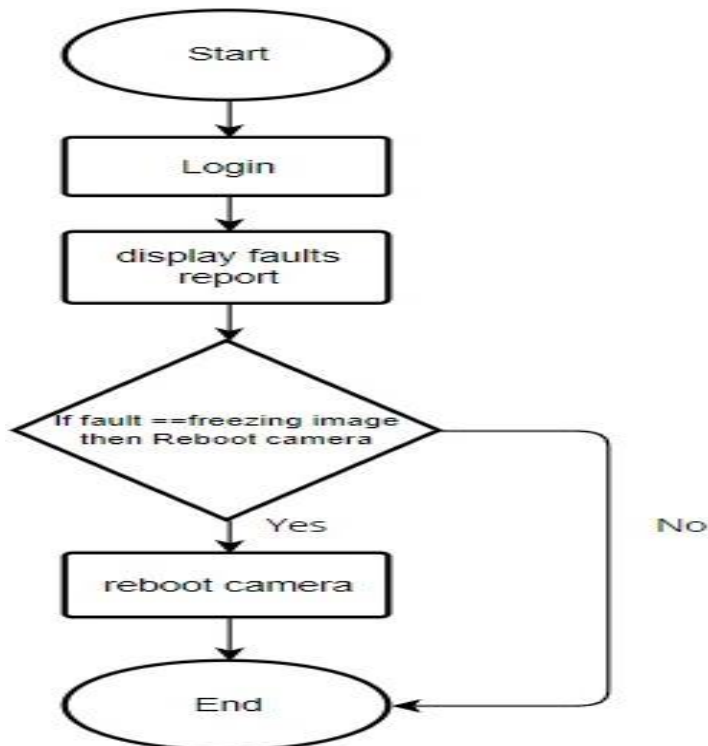


Figure 12. Freezing camera image, solution.

## 2- Incorrect date and time

The problem of changing the time or date of the camera, which results in a conflict between the recording time and the time stored in the hard disk, and this problem was fixed by updating the date or the incorrect time on the camera. Figure (13) illustrates how to solve this problem by model and figure (14) illustrate steps by a logarithm.

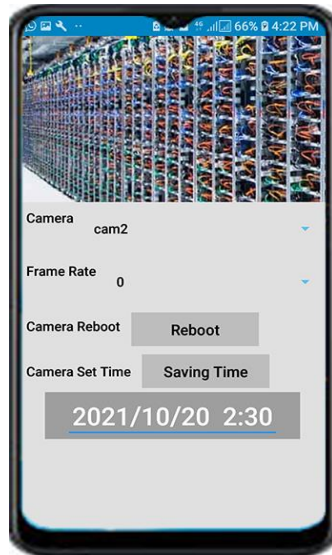


Figure 13. correct date and time for camera 2.

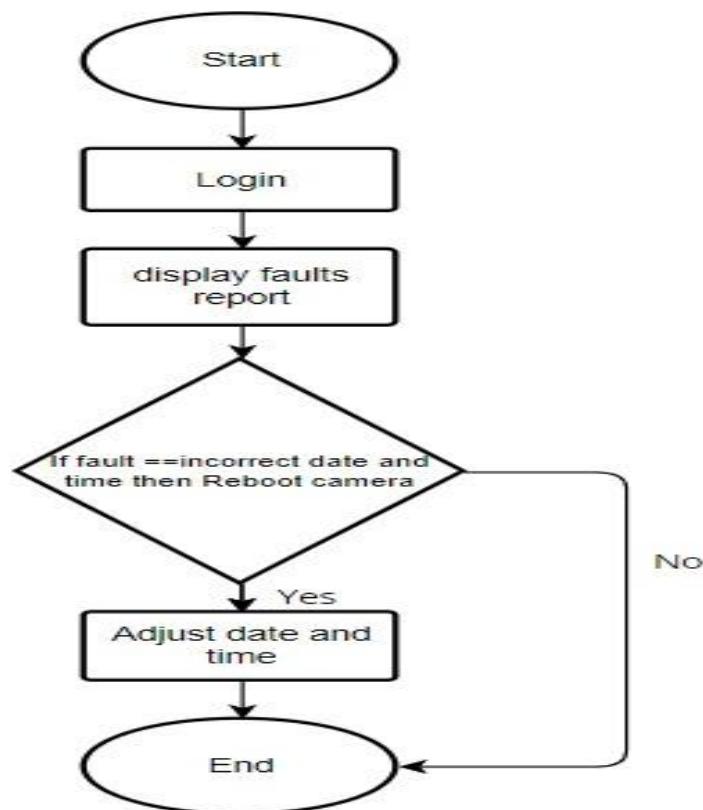


Figure 14. steps of Incorrect date and time solution.

### 3- Camera video delay

In order to solve the problem of slow video images due to the decrease in frames, The researchers can increase the number of frames remotely by a model. Figure (15) illustrates how to solve this problem by model, while figure (16) illustrates how to solve it by logarithm.

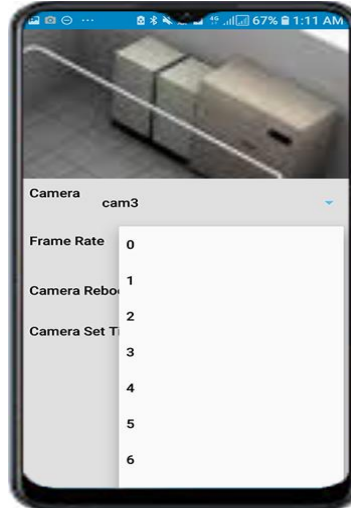


Figure 15. increasing frame rate for camera 3.

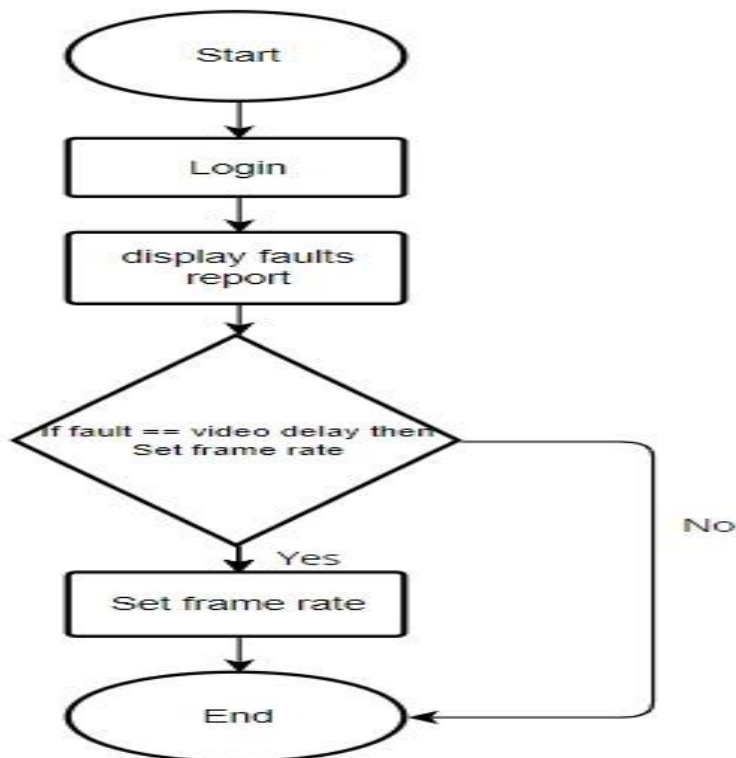


Figure 16. Step of video delay solution.

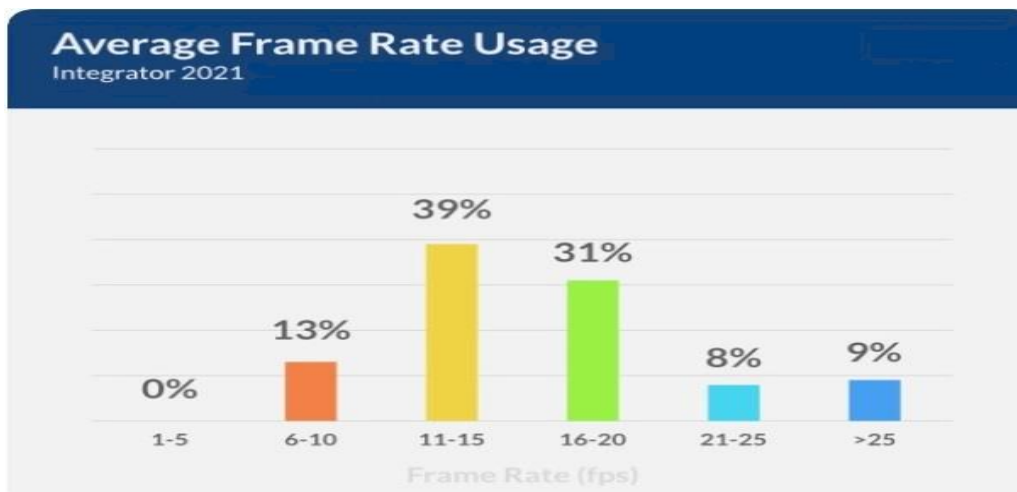
In below figure (17) Note, at 1 FPS, only 1-2 clear head shots are captured, but at 10 FPS, you get many more. The researchers notice in 1FPS video delay leads to missing frames and after increase frame rate to 10, the video was improved (no delay).



**Figure 17. comparison between 1fps and 10fps.**

The faster an object moves, the more likely to miss an action. the 'speed' with the frame rate (1 frame per second, 10 frames per second, 15 frames per second ,30, etc.), but how many frames do you need for reliable capture?

As shown, going from 10FPS or 15 FPS to 30FPS can notably increase storage costs but only marginally improve details captured. This average has increased from 10 - 15 FPS over the past years with many citing improvements in compression and more affordable storage. Show on figure (18).



**Figure 18. Average Frame Rate Usage.**

## 5. Conclusion

A data center is a physical facility where an organization stores its critical applications and data. CCTV surveillance systems must operate properly, without faults. For these reasons, the researchers developed an android model for monitoring and maintaining faults. In surveillance camera systems, there are faults that require maintenance, such as (image freezing, incorrect camera date and time, and video delay). In the future, the researchers will enhance the proposed model to detect cameras faults and maintain them automatically.

## Reference:

1. Rai M, Husain AA, Maity T, Yadav RK, Neves AJR. Advance intelligent video surveillance system (AIVSS): a future aspect. *Intell Video Surveill.* 2019;37.
2. Renkis M, Nashville and TN. "Surveillance monitoring systems and methods for remotely viewing data and controlling cameras". United States Patent, Jun. 22, 2021.
3. Donald FM. Information processing challenges and research directions in CCTV surveillance. *Cogn Technol Work.* 2019;21(3):487–96.
4. Hodgetts HM, Vachon F, Chamberland C, Tremblay S. See no evil: Cognitive challenges of security surveillance and monitoring. *J Appl Res Mem Cogn.* 2017;6(3):230–43.
5. Bobak AK, Hancock PJB, Bate S. Super-recognisers in action: Evidence from face-matching and face memory tasks. *Appl Cogn Psychol.* 2016;30(1):81–91.
6. Singh VK, Atrey PK, Kankanhalli MS. Cooperative multi-camera surveillance using model predictive control. *Mach Vis Appl.* 2008;19(5):375–93.
7. Haritaoglu I, Harwood D, Davis LS. A fast background scene modeling and maintenance for outdoor surveillance. In: *Proceedings 15th International Conference on Pattern Recognition ICPR-2000.* IEEE; 2000. p. 179–83.
8. Parida A, Kumar U. Maintenance performance measurement (MPM): issues and challenges. *J Qual Maint Eng.* 2006.
9. Abdelnaby M, Abd Elazem M, Aly HA, Kaboudan A. Augmented reality maintenance training with intel depth camera. In: *2017 International Conference on Machine Vision and Information Technology (CMVIT).* IEEE; 2017. p. 116–22.
10. Chae M-U, Lee CH. Automated Maintenance Inspection System for Unmanned Surveillance Equipment. *J Inst Converg Signal Process.* 2021;22(1):1–6.
11. Moon C, Kim S, Ryoo K. Design of Automatic Inspection System for Maintenance of Unmanned Security Facility. In: *INTERNATIONAL CONFERENCE ON FUTURE INFORMATION & COMMUNICATION ENGINEERING.* 2019. p. 207–10.

12. Shet VD, Harwood D, Davis LS. Multivalued default logic for identity maintenance in visual surveillance. In: *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. Springer; 2006. p. 119–32.
13. Alsyof I, Shamsuzzaman M, Abdelrahman G, Al-Taha M. Improving reliability of repairable systems using preventive maintenance and time-between-failures monitoring. *Eur J Ind Eng.* 2016;10(5):596–617.
14. Moon C, Kim S, Ryoo K. Automatic Positioning System for Maintenance of CCTV Camera. In: *INTERNATIONAL CONFERENCE ON FUTURE INFORMATION & COMMUNICATION ENGINEERING*. 2018. p. 131–4.
15. Salahat E, Saleh H, Mohammad B, Al-Qutayri M, Sluzek A, Ismail M. Automated real-time video surveillance algorithms for soc implementation: A survey. In: *2013 IEEE 20th International Conference on Electronics, Circuits, and Systems (ICECS)*. IEEE; 2013. p. 82–3.
16. Moon H-M, Pan SB. Implementation of the privacy protection in video surveillance system. In: *2009 Third IEEE International Conference on Secure Software Integration and Reliability Improvement*. IEEE; 2009. p. 291–2.
17. Linggang GU, Mingzheng Z. Intelligent surveillance system used one new method of image recognition. In: *2011 International Conference on E-Business and E-Government (ICEE)*. IEEE; 2011. p. 1–4.
18. Wang X. Intelligent multi-camera video surveillance: A review. *Pattern Recognit Lett.* 2013;34(1):3–19.
19. Venetianer PL, Deng H. Performance evaluation of an intelligent video surveillance system—A case study. *Comput Vis Image Underst.* 2010;114(11):1292–302.
20. Siergiejczyk M, Pas J, Rosinski A. Reliability and maintenance analysis of CCTV systems used in rail transport. *J KONBiN.* 2015;35(1):137.
21. Gulati R, Smith R. *Maintenance and reliability best practices*. Industrial Press Inc.; 2009.
22. Myrans J, Everson R, Kapelan Z. Automated detection of faults in sewers using CCTV image sequences. *Autom Constr.* 2018;95:64–71.
23. Isermann R. *Fault-diagnosis applications: model-based condition monitoring: actuators, drives, machinery, plants, sensors, and fault-tolerant systems*. Springer Science & Business Media; 2011.
24. <https://network-data-cabling.co.uk/blog/12-cctv-problems-and-fixes>. URL (last checked 11 March 2022).