
DEVELOPMENT OF DUAL POWER CLOSE CIRCUIT TELEVISION (CCTV) TRAINER WITH AUTOMATIC TRANSFER SWITCH (ATS)

Janice D. Marquez^{1*}, Nicky Jay R. Evangelista², Vincent M. Gonzaga³,
Jerico M. Aquino⁴, Christian Mark R. Revilloza⁵, Sjen Bouie A. Natanauan⁶
Cavite State University-CCAT Campus, Philippines

Abstract

This study focused on the development of dual power dual Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS). Specifically, this study aimed to design a dual-power CCTV Trainer with ATS; construct the trainer using available materials in the local market; test the functionality of the trainer in terms of parts identification, Digital Video Recorder (DVR) configuration, Pant Tilt Zoom (PTZ) IP camera configuration, one camera set-up, two camera set-up, three camera set-up and four camera set-up using dome, bullet and PTZ IP cameras; and evaluate the trainer in terms of functionality, workability, durability, economy, and safety. The overall dimension of the trainer was 183 cm (L) x 122 cm (H) with stand height of 61 cm. The major parts of the trainer consist of a miniature circuit breaker, ATS, a portable power station with a battery capacity of 151Wh (40800mAh), eight (8) channel centralized power supply, four (4) 12DC CCTV power supply, bullet type (conventional), bullet type (with night vision), dome type and PTZ IP camera, DVR with 12VDC power supply, IPS monitor with 12VDC power supply. The performance evaluation of the trainer was evaluated through parts identification, DVR configuration, PTZ configuration, one camera set-up, two camera set-up, three camera set-up, and four camera set-ups using a dome, bullet, and PTZ IP cameras. The result showed that the different laboratory activities designed for the trainer could be performed and operated properly.

Keywords: Automatic transfer switch; Close circuit television; Digital video recorder; Dual power; Trainer

Introduction

Closed-circuit television (CCTV) is crucial in ensuring that society has an efficient security and safety system. When compared to the cost of employing people to continuously monitor a certain activity or location, CCTV has been shown to be a more cost-effective method of providing security control and safety. CCTV surveillance systems offer a way to effectively deter theft, stop property damage, and identify offenders (Kruegle, 1992). Close circuit television has several applications. Speed monitoring for multiple vehicles using a CCTV Camera system that can monitor the speed of some vehicles and determine which vehicles have been detected breaking speed by tracking the vehicle using a matching-based method (Kurniawan, A, Ramadlan, A & Yuniano, 2018). Using the technology of tracking and face detection, it can develop a system that can detect human presence with the use of CCTV with face detection, which is expected to see the actual condition and detect any human presence on the video (Saputra & Amin, 2016). Moreover, the study on automated sewer pipe defect tracking in CCTV videos based on defect detection and metric learning proposed a framework for tracking multiple sewer defects in a learning-based detection model and a metric learning model using a sewer database. Using the detections and features from the trained models as inputs, the tracking module predicts tracks by Kalman filter associates tracked based on defect motion, appearance features, and defect types of pipes (Wang, Kuma, & Cheng, 2021). Lastly, with object recognition and security improvement by enhancing the features of CCTV, the CCTV will not only capture things but also recognize the threat and take action accordingly (Kanyal et al., 2020).

Considering the different applications of CCTV cameras, learning their operation, installation, and maintenance was very important. In the Bachelor of Science in Industrial Technology (BSIT) program with a specialization in electronics technology at Cavite State University- CCAT Campus, one of the major subjects is Electronics Communication which needs theoretical and practical application of the subject. Under this subject, CCTV installation and maintenance is a major topic being discussed and performed.

Moreover, in Electronics Technology, one of its National Competencies (NC) is Electronic Products Assembly and Servicing NCII, whereas CCTV installation and maintenance is one of the competencies under this type of NC. Considering the scenario, a trainer for CCTV is necessary for electronics technology and Electronic Products Assembly and Servicing (EPAS) NCII to enhance the theoretical and technical skills of students and other beneficiaries.

Materials and Methods

This study is a research and development which produces dual power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS).

Materials

The dual power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS) was composed of eight (8) major parts, namely short circuit protection device, main power supply circuit, automatic switching device, camera power supply, CCTV cameras, video and audio recording device, monitoring device and connecting cable for CCTV installation and maintenance.

Short Circuit Protection Device. A 220V, 10A miniature circuit breaker that automatically turns OFF when an overload occurs.

Main Power Supply Circuit. A 220VAC power source which serves as the main power source for the trainer or portable power station with the input of 15VDC, 2.5A, the output of 220VAC, and a battery capacity of 151Wh (40800mAh), which serves as backup power for the trainer when a power interruption occurs.

Automatic Transfer Switch (ATS). A 230VAC, 2 Position, 63A input that serves as the automatic switch for 220VAC or portable power source for the trainer.

Camera Power Supply. A 220VAC input with 8 channel 12VDC, 10A output which serves as a power supply for the CCTV cameras or 12VDC CCTV Power Supply with 220VAC input with 12VDC, 1A output which serves as a power supply for one CCTV camera.

CCTV Cameras. A Bullet Type Camera (conventional), Bullet Type Camera (with night vision, dome Type Camera, and Pan Tilt Zoom (PTZ) IP camera were used to capture video and audio information.

Video and Audio Recording Device. A Digital Video Recorder DVR uses 12VDC input which records the audio and video information captured by the CCTV cameras. It used 320GB Hard Disk Drive Memory which serves as a memory storage area for the bullet type and dome type cameras, and 32GB External Memory for PTZ IP Camera.

Monitoring Device. It uses IPS monitor with 12VDC input, which displays the video information captured by the bullet type (conventional), bullet type (with night vision), and dome type cameras

Connecting Cable. A Siamese wire serves as connecting wire for the CCTV camera power supply and video signal.

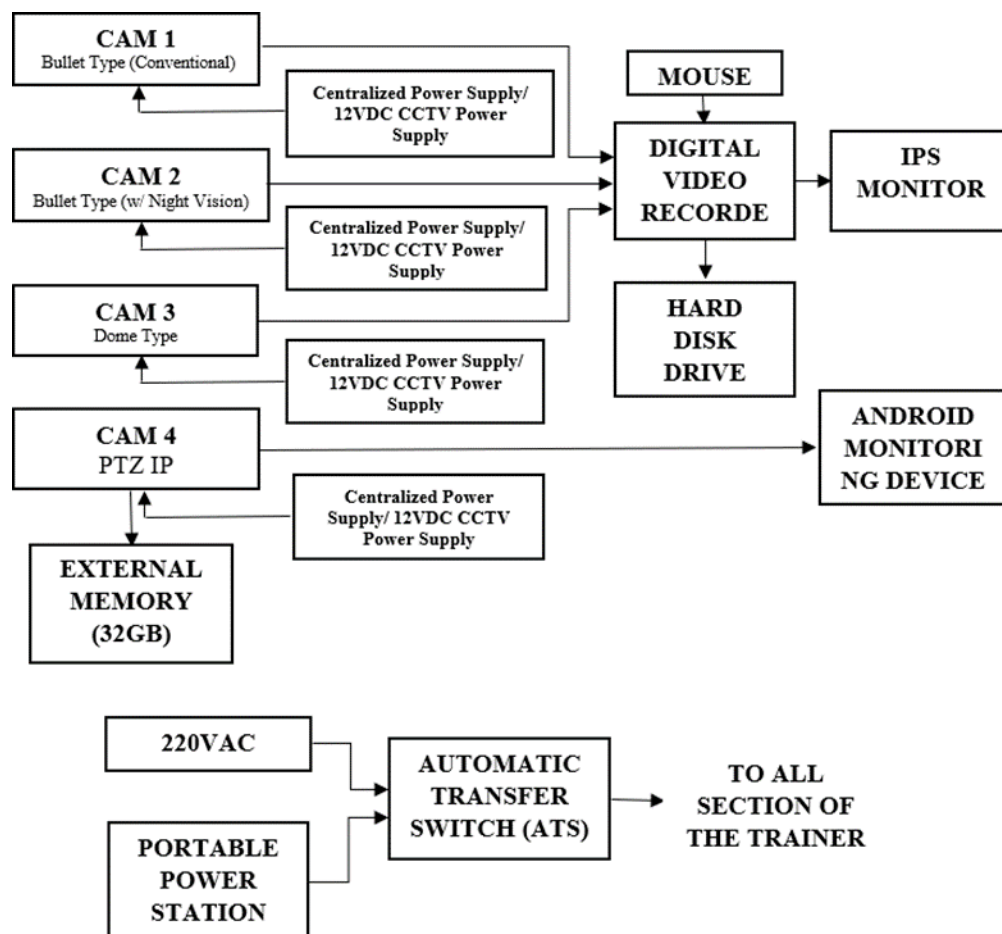


Figure 1. Block Diagram of Dual Power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS)

Methods

The researchers used development research designs which focused on the development of dual power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS). It includes processes such as the need analysis stage, design, construction, testing, and evaluation. In the need analysis stage, a Focus Group Discussion (FGD) with experts was conducted with faculty who teach Electronics Communication subjects to map the competency requirements and basic practice materials needed in the subject. In the design stage, the design is carried out with the input of the experts and faculties who teaches the subject related to the trainer. The construction or fabrication stage is the construction of the trainer based on its design and desired application. The testing, was done through assessing the performance of a different components of the trainer and functionality of the trainer when performing laboratory activities on parts identification, DVR configuration, PTZ configuration, one camera set-up, two camera set-up, three camera set-up and four camera set-ups using a dome, bullet, and PTZ IP cameras was tested by the researchers. Finally, in the evaluation stage, the evaluation was carried out by 10 experts and 20 students by observing the performance of the trainer when laboratory activities were being performed. Also, the trainer was evaluated in terms of functionality, workability, durability, economy, and safety using a 5-point Likert scale.

Results and Discussions

Performance testing of Dual Power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS)

As shown in Table 1, all the components in the Dual Power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS) operates properly based on its intended function.

Table 1. Performance testing of components Dual Power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS)

Part	Performance Function	Function Properly		Explanation (Good or Not Good)
		Yes	No	
<i>AC Power Supply, 220VAC</i>	Input Voltage: 220VAC	/		Good
<i>Portable Power Station, Battery Capacity: 151Wh (40800mAh)</i>	Input Voltage: 15VDC, 2.5A Output Voltage: 220VAC	/		Good
<i>Portable Power Station Charger</i>	If supplied by 220VAC, the output is 15VDC	/		Good
<i>Miniature Circuit Breaker, 220VAC, 16A</i>	ON, if there is an overload.	/		Good
<i>Automatic Transfer Switch (ATS), 230VAC, 2 Position, 63A</i>	If position 1 is ON, position 2 is OFF, and if position 1 is OFF, position 2 is ON.	/		Good
<i>8 Channel Centralized Power Supply, 12VDC, 10A</i>	Input: 220VAC Output: 12VDC per channel	/		Good
<i>CCTV Power Supply, 12VDC, 1A</i>	If supplied by 220VAC, the output is 12VDC	/		Good
<i>Bullet Type Camera (Conventional), 12VDC</i>	If supplied by 12VDC and then connected to DVR input, the captured image should appear on the IPS monitor	/		Good
<i>Bullet Type Camera (with Night Vision), 12VDC</i>	If supplied by 12VDC, then cover the LED on the lens, the IR LED will be energized.	/		Good
<i>Dome Type Camera, 12VDC</i>	If supplied by 12VDC and then connect to DVR input, the captured image should appear on the IPS monitor.	/		Good
<i>Pan Tilt Zoom (PTZ) IP Camera, 12 VDC</i>	If supplied by 12VDC, then configured for pairing via Android application, capture audio and video can be monitored and recorded to an Android device	/		Good
<i>Digital Video Recorder (DVR)</i>	If supplied by 12VDC, then every channel has an input camera with DVR output connected to an IPS monitor. The captured image should appear on the IPS monitor.	/		Good
<i>Digital Video Recorder (DVR) Power Supply, 12VDC, 1.5A</i>	If supplied by 220VAC, the output is 12VDC	/		Good
<i>IPS Monitor</i>	If supplied by 12VDCAC, then have video input coming from the DVR. The captured image should appear on this IPS monitor.	/		Good
<i>IPS Monitor Power Supply, 12VDC, 1.5A</i>	If supplied by 220VAC, the output is 12VDC	/		Good

Testing result of dual power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS)

The dual power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS) was designed to perform different laboratory on CCTV installation and maintenance such as CCTV trainer parts identification, Digital Video Recorder (DVR) configuration, Pan Tilt Zoom (PTZ) IP Camera configuration, CCTV installation with one (1) camera set-up using a different type of camera, CCTV installation with two (2) camera set-up using different camera combination, CCTV installation with three (3) camera set-up using different camera combination and CCTV installation with four (4) camera set-up using conventional bullet type, with night vision bullet type, dome type, and PTZ IP camera.

As shown in Table 2, the results showed that different circuit connections or laboratory activities on CCTV installation and maintenance, such as Close Circuit Television (CCTV) trainer parts identification, Digital Video Recorder (DVR) configuration, Pan Tilt Zoom (PTZ) IP Camera configuration, CCTV installation with one (1) camera set-up using a different type of camera, CCTV installation with two (2) camera set-up using different camera combination, CCTV installation with three (3) camera set-up using different camera combination and CCTV installation with four (4) camera set-up using conventional bullet type, with night vision bullet type, dome type, and Pan Tilt Zoom (PTZ) IP camera could be performed and operates properly using the trainer which uses 8 channel centralized power supply and 12VDC CCTV camera power supply for the cameras.

Table 2. The test result of dual power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS) that uses 8 channel centralized power supply and 12VDC power supply for the cameras

Laboratory Activities Using the Trainer	Trainer that uses 8 channel centralized power supply for the cameras			Trainer that uses 12VDC CCTV power supply for the cameras		
	Average time consumed of ATS before transferring the contacts	Can it be performed using the trainer?		Average time consumed of ATS before transferring the contacts	Can it be performed using the trainer?	
		Yes	No		Yes	No
<i>Close Circuit Television (CCTV) trainer parts identification</i>	-	/	Good	-	/	Good
<i>Digital Video Recorder (DVR) Configuration</i>	-	/	Good	-	/	Good
<i>Pan Tilt Zoom (PTZ) IP Camera configuration</i>	-	/	Good	-	/	Good
<i>CCTV installation with one (1) camera set-up (Conventional Bullet Type Camera)</i>	1.62	/	Good	1.10	/	Good
<i>CCTV installation with one (1) camera set-up (with Night Vision Bullet Type Camera)</i>	1.36	/	Good	0.93	/	Good

<i>CCTV installation with one (1) camera set-up (Dome Type Camera)</i>	1.26	/	Good	1.34	/	Good
<i>CCTV installation with one (1) camera set-up PTZ IP Camera)</i>	1.02	/	Good	1.53	/	Good
<i>CCTV installation with two (2) camera set-up (Conventional and with Night Vision Bullet Type Camera)</i>	1.03	/	Good	1.58	/	Good
<i>CCTV installation with two (2) camera set-ups (Conventional Bullet Type and Dome Type Camera)</i>	1.46	/	Good	1.34	/	Good
<i>CCTV installation with two (2) camera set-ups (Conventional Bullet Type PTZ IP Camera)</i>	1.31	/	Good	1.56	/	Good
<i>CCTV installation with two (2) camera set-ups (with Night Vision Bullet Type and Dome Type Camera)</i>	1.14	/	Good	1.62	/	Good
<i>CCTV installation with two (2) camera set-ups (with Night Vision Bullet Type and PTZ IP Camera)</i>	1.96	/	Good	1.44	/	Good
<i>CCTV installation with two (2) camera set-ups (Dome Type PTZ IP Camera)</i>	0.83	/	Good	1.70	/	Good

<i>CCTV installation with three (3) camera set-ups (Conventional Bullet Type, with Night Vision Bullet Type, and Dome Type Camera)</i>	1.16	/	Good	1.80	/	Good
<i>CCTV installation with three (3) camera set-ups (Conventional Bullet Type, with Night Vision Bullet Type, and PTZ IP Camera)</i>	1.21	/	Good	1.60	/	Good
<i>CCTV installation with three (3) camera set-ups (Conventional Bullet Type, Dome Type Camera, and PTZ IP Camera)</i>	1.20	/	Good	1.50	/	Good
<i>CCTV installation with three (3) camera set-ups (with Night Vision Bullet Type, Dome Type, and PTZ IP Camera)</i>	0.86	/	Good	1.50	/	Good
<i>CCTV installation with four (4) camera set-ups (Conventional Bullet Type, with Night Vision Bullet Type, and Dome Type, and</i>	2.54	/	Good	1.95	/	Good

Respondent's Evaluation

The performance of the trainer was also assessed in terms of functionality, workability, durability, economy, and safety. The results of the evaluation are shown in Table 3.

Table 3. Respondents' evaluation of the characteristics of the dual power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS)

Criteria	Experts		Students	
	Mean	Interpretation	Mean	Interpretation
Functionality	4.87	Outstanding	4.88	Outstanding
Workability	4.80	Outstanding	4.87	Outstanding
Durability	4.67	Outstanding	4.85	Outstanding
Economy	4.73	Outstanding	4.87	Outstanding
Safety	4.73	Outstanding	4.83	Outstanding
Grand Mean	4.76	Outstanding	4.86	Outstanding

The mean rating for each criterion revealed that the respondents are satisfied with the characteristics of the trainer, having a grand mean rating of 4.86 for students described as outstanding and a grand mean rating of 4.76 for experts also described as outstanding. Based on students' evaluation, the characteristic of the trainer with the highest rated mean was functionality at 4.88, with the lowest rated mean of 4.83 for safety, while for experts' evaluation, the highest rated mean was functionality at 4.87, and the lowest mean was for durability at 4.67.

These findings generally show that dual power Close Circuit Television (CCTV) Trainer with automatic transfer switch functions well, and laboratory activities intended for this trainer can be performed. Furthermore, the expertise and materials used in constructing the trainer were locally available and of high quality.

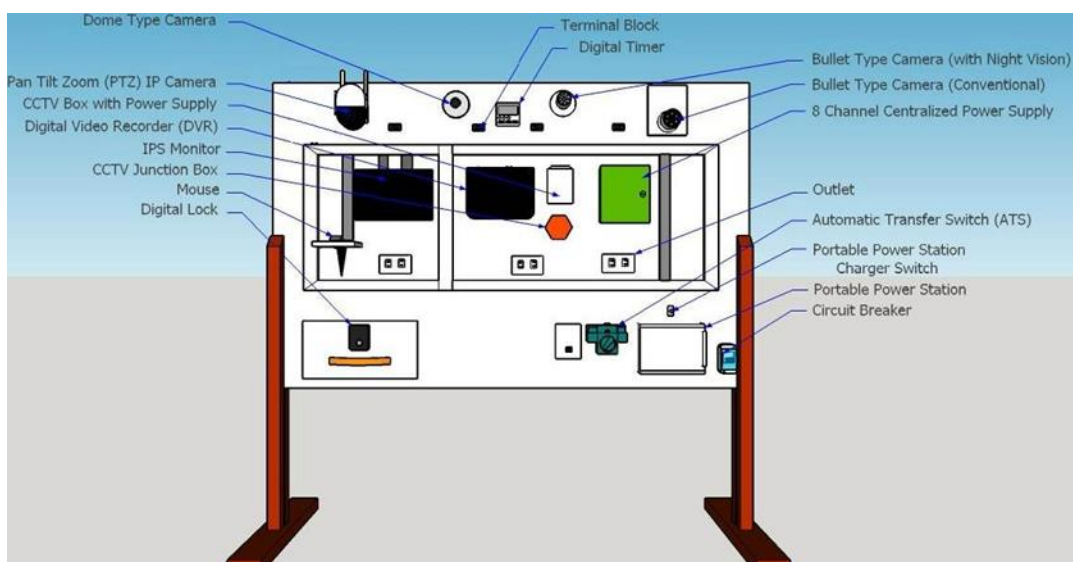


Figure 2. Dual Power Close Circuit Television (CCTV) Trainer with Automatic Transfer Switch (ATS) (the actual prototype is for IP application under CvSU-CCAT Campus)

Conclusion

Based on the results of the study, the dual power Close Circuit Television (CCTV) Trainer with automatic transfer switch was properly designed and fabricated using locally available materials. Based on the testing, the components used in the trainer function properly, and the trainer can be used for different laboratory activities in parts identification, DVR configuration, PTZ configuration, one camera set-up, two camera set-up, three camera set-up and four camera set-up using a dome, bullet, and PTZ IP cameras. Lastly, based on the result of the evaluation, the trainer possessed outstanding characteristics in terms of functionality, workability, durability, economy, and safety, as

evaluated by the respondents. For future studies, the researcher may use a higher current on a portable power station for less time delay of automatic transfer switch (ATS) to transfer the contact and for long usage of back-up power and use pre-test and post-test to evaluate the performance of students using the trainer.

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