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Networking CCTV Cameras & Passive Infra-Red Sensors for E-classroom Monitoring System: Proactive Approach to Quality Assurance in Education System

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----------**ABSTRACT**----------
Quality assurance in education system is paramount to the global sustainable development, therefore conventional surveillance systems that use cameras and process large amounts of data to extract features from a classroom environment may be essential. This work presents the design and implementation of automated classroom monitoring and security system with CCTV cameras and PIR sensors to monitor student's behavior and observe teacher performance during classroom activities. An active central control system and PIR sensors was designed. CCTV cameral, DVD system, and PIR sensors were networked to implementing the e-monitoring system. The control system supply power to both cameras and PIR sensor. The PIR sensors senses the movement within the monitoring area, and then activate the cameras, then the DVD system start recording the activities for online or offline view by human agent.

Keywords -**CCTV, PIR sensors, student's behavior, teacher's performance, quality assurance.**

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I. INTRODUCTION

This research work use Yaba College of Technology as a case study. There are three general goals of education that provide a solid starting point for the analysis of any existing or purposed of educational system. These goals are acquisition & retention, understanding, and use of knowledge & skills. These goals have endured over the years [1].

The educational system must focus on producing a graduate that could add value to the society by applying their learning experience in school to solve problem in their society. Educational planners are therefore faced with challenge of providing quality education. Hence quality assurance is paramount in any educational system via quality control. Quality control practices in Nigerian education are based essentially on: School inspection, Monitoring. Control School inspection has been criticized for its inadequacy to assist classroom teachers to improve their performance**.** Surveillance of the classroom is paramount to quality learning outcome. Surveillance is the systematic investigation or monitoring of the actions or communications of one or more persons in a place [3].Security surveillance system could help in reducing crime rate in our society.

The policing and monitoring of classroom during lecture, and examinations are part of the responsibilities given to the Academic Planning Unit (AOU), Internal Quality Assurance (IQA) unit by the college through office of Deputy Rector Academic. The use of a surveillance system for audio and image detection, feature extraction and recognition from event location is becoming more important as it can serve as paperless and undeniable evidence, but academic institutions have not been utilizing this technology for education sustainability. Securing quality assurance in education system is paramount to the global sustainable development, hence conventional surveillance systems that use cameras and

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process large amounts of data to extract features from a particular location may be essential [4].

This paper is focus on design and implementation of multimodal operation CCTV surveillance system for the purpose of Monitoring of Classroom Activity from Far and Near with CCTV Cameral and Passive Infra-Red Sensor.

This work will be based on software designs, hardware design and implementation of a system that enables a remote personal computer (PC) which is connected to a wireless local area network to view the activities captured by a surveillance camera. The system will provide remote access and greater flexibility compared to other visual surveillance systems, as the system can be hosted on the internet and send signal to the user anywhere in the world. Suppose educational administrator place a camera in one particular room which is to be monitor, the administrator can still monitor that same classroom from far, as he/she can make use of remote surveillance system by use of PC through internet facility.

The alerting sensors with low-power consumption, and camera are placed in the classrooms. Based on the sensors signals received by the controller, the image or data is captured and viewed from a PC or android phone through a web application and thus view and recorded for evidence when needed. Educational administrators can access to the monitoring system remotely via the internet using Windows-based Remote Desktop program from a personal computer. It is commonly deployed in city and campus applications, or any place where it is difficult to monitor the surroundings using common means. Remote surveillance is a great opportunity to use wireless technologies for connectivity due to the flexibility they provide. Surveillance security systems monitor the activities that go on in areas of the establishment with the use of surveillance cameras [5].

This research report is organized as follows: section two gives the summary of review work. The sections three give a detailed description of the proposed system architecture, hardware and software module, and the interconnectivity of the components. Section 4 illustrates the step by step implementation of the proposed system and testing/result. In section 5, we have Further Research Direction, recommendation and conclusion.

A. Research Aim/Objectives

The aim of this research work is to design and implement a multimodal operation CCTV surveillance system for the purpose of Monitoring of Classroom Activity from Far and Near with CCTV Cameral and Passive Infra-Red Sensor. When this system is completed the following objectives can be achieving.

- Stress free monitoring of the classroom activities from far and nearby Deputy Rector Academic, Director APU, Director IQA and any other college official with access right to do so.
- Clear and undeniable evidence in case of security breach or manipulation of rules during lectures/examination.
- Enhance quality of teaching and learning especially for the class/s where the system is installed. Since the lecturer/instructor don't know who may be watching them during the lecture/exam they would want to do everything possible to avoid been challenge for any act of misconduct during exam/lecture. Hence enhance quality.
- Reduction in specific academic crime(s): A common objective for the use of CCTV is to reduce specific crimes in specific locations.

B. Statement of Problem

The negligence of duties by the lecturers in higher institutions of learning and criminal activities and disturbances of students by the students especially when the class is not engage by the lecturers require urgent attention as this could affect negative the learning outcome and can also impact negative to sustainable development of a nation.

II. LITERATURE REVIEW

A. Obstruction in the use of CCTV

A major setback with CCTV systems is its fixed nature and lack of flexibility. The monitor on which activities are viewed is always at a fixed position, thus for effective real time surveillance monitoring, the person to do the monitoring must always be at the position where the monitor is permanently stationed which is quite task if long hours are to be involved [6]. Some CCTV surveillance does not allow remote monitoring and remote monitoring that enables a remote personal computer (PC) which is connected to a wireless local area network to view the activities captured by a surveillance camera, is essential for flexibility [7]. Also some ordinary CCTV does not produce clear image that may be require as evidence when needed and also not having features to protect the view data from unauthorized viewers. Digital video from cameras can be encrypted, thus providing security from unauthorized persons [8].

B. Surveillance System Techniques

Some of the techniques for design and implementations of surveillance system are: *Surveillance System Using Sensors*: in recent time remote security surveillance systems are constructed with sensors which include microwave detectors, photoelectric detectors, infrared detectors, and many others; *Surveillance System Using Discrete wavelets transform*: A new method for detecting and tracking multiple moving objects based on discrete wavelet transform and identifying the moving objects by their color and spatial information is now becoming a good technique of design a surveillance system. Discrete wavelet transform (DWT) can divide a frame into four different frequency bands without loss of the spatial information; *Surveillance System Using AMD Algorithm*: this allows the real-time detection of human in a video stream acquired by a static camera. An AMD algorithm is used to achieve complete motion detection of moving objects by involving three significant modules background

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modelling (BM), an alarm trigger module (AT) and an object extraction (OE) [9].

III. RESEARCH METHOD AND DESIGN

A. Data Collection

Information was gathered on the require tools for the design and implementation of the proposed system as follows.

Step-down Transformer: In this work a step down transformer is used which steps down 220volt AC to 12volt DC.

Diode: A diode is a specialized electronic component with two electrodes called the anode and the cathode. Diodes in this circuit are used as a bridge rectifier to remove some of the element of alternating current flowing through the circuit and make it a pure direct current. The diode use here is an IN4007 diode; four IN4007 diodes are connected together as a bridge rectifier (diode D1 to D4). The cathode of D1 is connected to the anode of D2, the cathode of D1 is connected to the cathode of D3, and the anode of D3 is connected to the cathode of D4 while the anode of D4 is connected to the anode of D1 to form a bridge rectifier.

Resistor: The resistor's resistance limits the flow of electrons through the circuit. It is used in this circuit is to limit the amount of current that will flow through the circuit.

Capacitor: A capacitor is a two terminal electrical component. Capacitor in this circuit is used to store charges,

Voltage Regulator: The voltage regulator is usually used in electronic circuit that requires a regulated power supply. In this work a regulated power supply of 5volts is required for the sensor while 12volt supply is required for the camera and DVR, for the 5volt supply 7805 regulators is used while 7812 is used for the 12volt supply the last two digit indicate the output supply voltage.

Monostable (555 TIMER): The 555 timer is used to provide a time delay in the circuit, the timer is set to be delayed for two minutes once the sensors are no longer sensing any image before it triggers the supply to the camera off. The circuit is a monostable which means it will turn on the LED for about 2 minutes when the Sensors are not sensing any motion. The time period is determined by R1 and C1 and we may wish to try changing their values. R1 should be the range 1 kilo ohms to 1 Mega ohm.

Mathematically:

$$\text{Time Period, } T = 1.1 * R1 * C1$$

Light Emitting Diode (Light Indicator): Five LEDs will be used in this circuit, one to indicate there is power supply to the circuit, another to indicate there is power supply to the cameras and DVR while the remaining three is to indicate that the PIR sensors are sensing. Each LED are connected to the output of the OR gate and turns ON if any of them is high.

Transistor (BC547): The transistor in this circuit is connected with a resistor to the output of the three input OR gate and the output if low is being converted to high.

Three Input Or Gate: The OR gate in figure 9 is a digital logic gate that implements logical disjunction it behaves according to the truth table to the right. A HIGH output (1) results if one or both the inputs to the gate are HIGH (1). If neither input is high, a LOW output (0) results. In this circuit the sensors are connected to the OR gate and a high in any of the sensor will result in a high at the output and a low in the three sensors at the same time will result in low at the output.

Passive Infra-Red Sensor: The PIR (Passive Infra-Red) sensor is a pyroelectric device that detects motion by sensing changes in the infrared (radiant heat) levels emitted by surrounding objects. This motion can be detected by checking for a sudden change in the surrounding IR pattern. When motion is detected the PIR sensor outputs a high signal on its output pin. This logic signal can be read by a logic circuit or used to drive an external load. The sensor detects a person up to approximately 30ft away, or up to 15 ft away in reduced sensitivity mode, its Jumper selects normal operation or reduced sensitivity, Source current up to 12 mA @ 3 V, 23 mA @ 5 V, LEDs light up the lens for fast visual feedback when movement is detected, Small size makes it easy to conceal, easy interface to any logic circuit, operating temperature: 32 to 122 °F (0 to 50 °C), the sensors in this circuit is interfaced to a mono stable and an OR gate circuit. The sensitivity of the PIR Sensor varies with temperature and other environmental conditions. Generally, when in reduced sensitivity mode, the PIR sensor will detect an object at up to half the distance it would in normal operating mode.

Web Camera: The web camera figure 12, is one of the major component in this research work, it is responsible for the image capturing, the image/video captured by the camera may be saved, viewed or sent on to other networks via systems such as the internet, and email as an attachment. When sent to a remote location, the video stream may be saved, viewed or send.

Personal Computer/android Phone: A personal computer PC/android phone figure 13 can be a desktop computer or a Laptop computer and can be used to view the image/video being captured by the camera and it can be at any remote location. Also any smart phones like Android phone, Blackberry, IPhone etc. can also be used to monitor remotely by installing the monitoring program or by using a web application installed on these devices.

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B. System Design

The control system is design with the use of some of the tools discussed in section 3.1; control circuit system was design with the circuit diagram in figure 1.

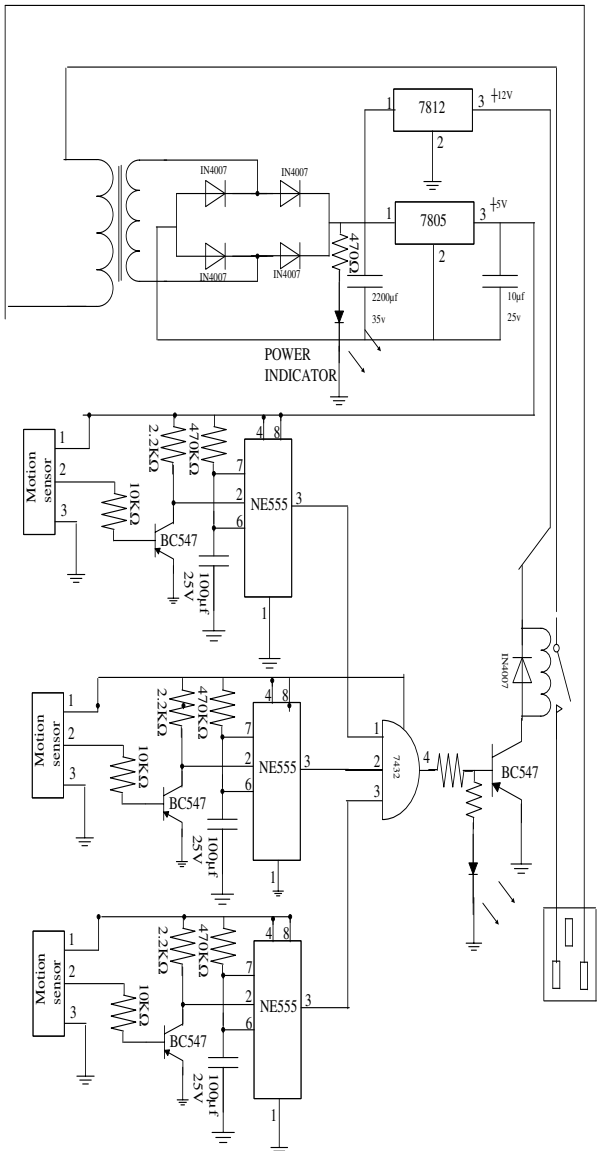

Fig 1. Control Unit Circuit diagram

C. Proposed System Working Mechanism

In this surveillance system, three analogue cameras are attached to a digital video recorder through a coaxial cable for video signal. When the PIR sensor detects intruder, the camera activated and captures the activities of the intruder. Subsequently, the camera starts recording video of the monitored area and save it into memory storage for future retrieval and analysis.

The main software program in this research work is the PC-based Graphic User Interface (GUI) application software for web-camera to capture video of the monitored area. The camera will remain ON, after two minutes without any activities of intruders it goes OFF and it will remain OFF for the rest of the time until an intruder is detected. By doing so, the cost of memory storage and power consumption can be reduced.

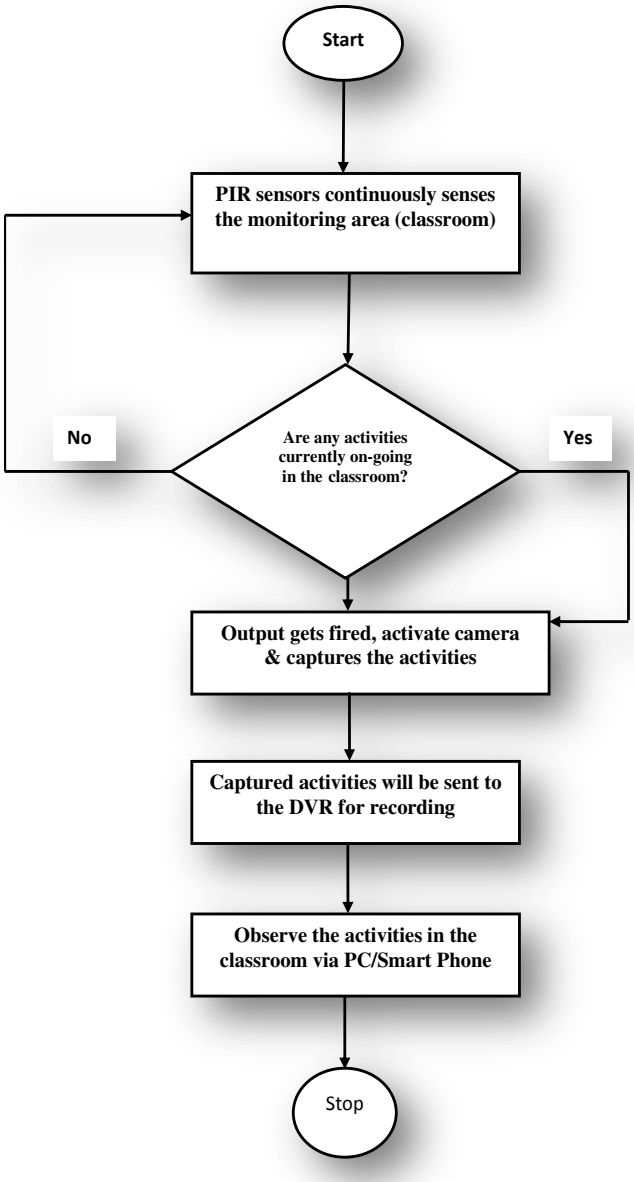

Fig 2. Flowchart for Proposed System Working Mechanism

Figure 2 is the flowchart that illustrate how the proposed system will work the first oval shape is the start which prompt the system to begin and all the rectangular shape is the process involve in the system mechanism for initialization, the rhombus shape is for decision the system makes decision at that point; is the intruder present within the range if Yes the system continues the process, if No the sensor continue to sense as seen in the flowchart above.

D. System Architecture and Data Flow

The diagram in figure 3 shows the stages involve in the overall system design and operations. There are seven

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stages involve, and figure 4 depicts the interconnectivity of the components and its operations (system architecture).

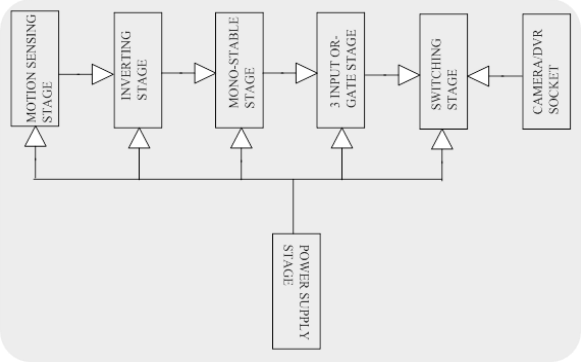

Fig 3. Block diagram of stages involve in the system

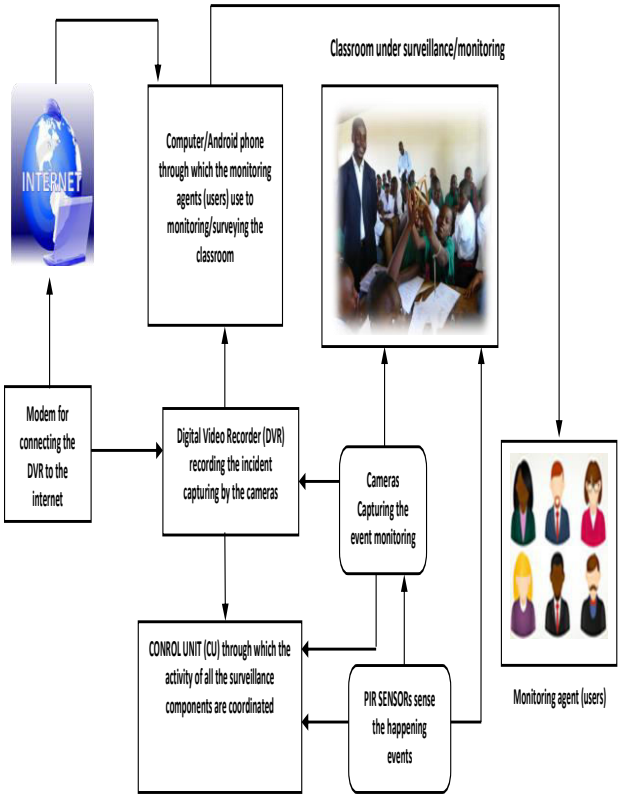

Fig 4. Proposed Systems Architecture & Data Flow

IV. SYSTEM IMPLEMENTATION AND TESTING

A. System Implementation

The PIR sensors is connected to the mono stable circuit and the OR gate inside the control unit, the cameras have signal cable and power cable the signal cable is being connected to the DVR while on the power of the camera is being connected to the output of the control unit, the monitor is being connected to the DVR with the aid of a VGA cable for the local or standalone user in the monitoring location, then the DVR is connected to a modem with the use of a RJ45 cable, the modem is being connected to the internet so that the remote user will be able to view the activities going on. System implementation and testing was done according to the steps and procedure illustrate as follows.

The proposed system control unit was implemented on a printed circuit board. The materials used in designing the printed circuit board are listed below: Over Head Projector sheet (known as OHP sheets) or a wax paper; Laser Printer; Electric Iron; Steel wool; Two plastic trays; Copper board/ PCB (paper phenolic); Black permanent marker; Etching solution (Ferric chloride); Drill machine; steps-by-steps illustration of the design PCB/control unit circuit design is as follows:

Step 1: We prepared a layout of the circuit on PCB designing software called proteus. A layout is a design which interconnects the components according to the circuit diagram in fig 1. We took a mirror image print of the layout on the OHP sheet using a laser printer, and we cut the copper board according to the size of the circuit layout. A copper board is used as the base of a PCB.

Step 2: Steel wool was used to rub the copper side of the PCB in other to removes the top oxide layer of copper as well as the photo resists layer.

Step 4: The OHP sheet (wax paper) which has the printed layout was place on the PCB sheet, and we put a white paper on the OHP sheet and start ironing. The heat applied by the electric iron causes the ink of the traces on the OHP sheet to stick on the copper plate exactly in the same way it is printed on the OHP sheet. This means that the copper sheet will now have the layout of the PCB printed on it see figure 18, we allow the PCB plate to cool down and slowly remove the OHP sheet, and permanent marker was used to complete the tracks that are missing properly.

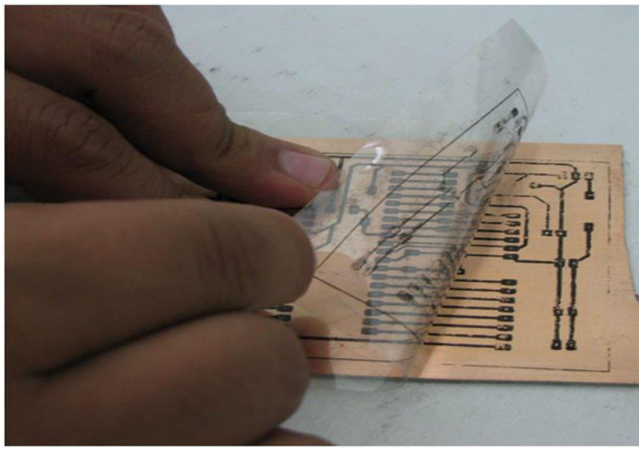

Fig 5. Opening of the Ironing on the PCB

Step 5: The layout is printed on PCB. The area covered by ink is known as the masked area and the unwanted copper, not covered by the ink is known as unmasked area. Now we make a solution of ferric chloride. Then we take a plastic box and fill it up with some water. After that we dissolve 2-3 tea spoon of ferric chloride power in the water. Then we dip the PCB into the Etching solution (Ferric chloride solution, $Fecl_3$) for approximately 30mins.

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The $Fecl_3$ reacts with the unmasked copper and removes the unwanted copper from the PCB. This process is called as Etching. Plier was use to take out the PCB and check if the entire unmasked area has been etched or not.

Step 6: The PCB was taken out and was washed in cold water and we remove the ink by rubbing it with steel wool. The remaining area which has not been etched is the conductive copper tracks which connect the components as per the circuit diagram in figure 14.

Step 7: Then we carefully drill the PCB using a drilling machine on the pads. After that we insert the components in the correct holes and solder them as seen in figure 6 and figure 7.

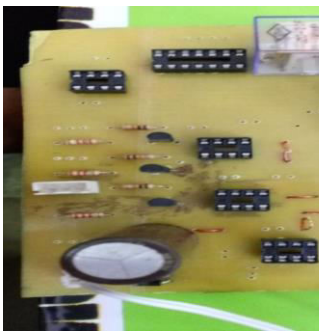

Fig 6. Fixing the components on the PCB

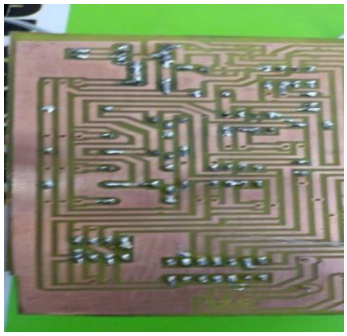

Fig 7. Soldering the components on the PCB

After soldering the components on the printed circuit board it was then housed in a casing for packaging, the sensors also were housed in their various casing to make it easier for the installation. After coupling the control unit circuit in the casing and the PIR sensors, the camera and the DVR was connected to the output supply of the control unit through the power cable. Then the camera was connected to the DVR with the coaxial cable fixed with BNC connector to send captured image to the DVR and the DVR was connected to the monitor. Figure 8 shows the control unit and PIR sensors packaging, while figure 9 shows the prototype of the proposed system.

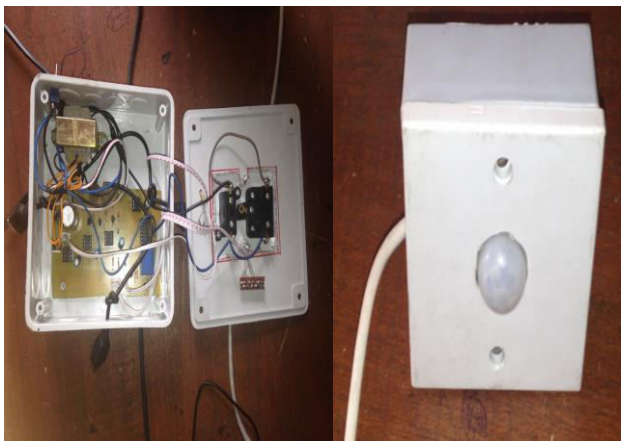

Fig 8: Control system and PIR Sensor

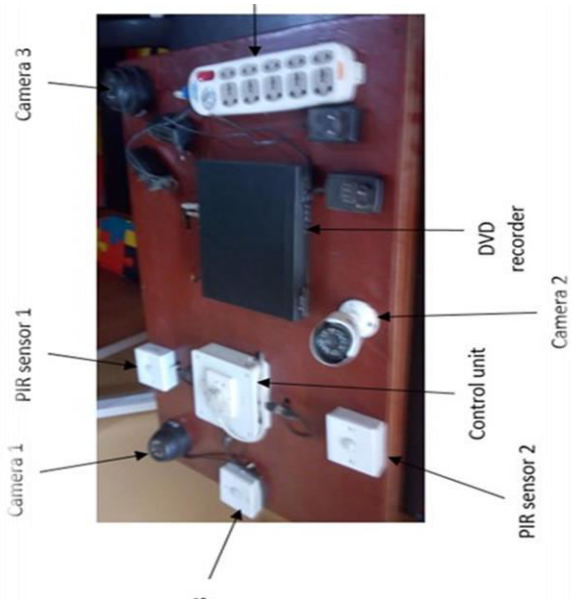

Fig 9: prototype of the proposed system

B. Proposed System Testing

The components were connected as indicated in the system architecture/data flow. The system was tested and confirm working, the sensors senses the information in the monitoring classroom and activated the cameras which then captured the situation event that was recorded by DVR through which the users monitoring the situation in the classroom. The output of the system is as shown in figure 10 for the class been monitored.

Fig 10. Showing Monitoring Classroom

V. CONCLUSION

The policing and monitoring of classroom during lecture, and examinations are part of the activities required to enhance quality assurance in the teaching and learning outcomes. This work has present automation of classroom monitoring with the use of CCTV cameras and PIR sensors for proactive surveillance of the classroom by school managers from far and near. The system can serve as paperless and undeniable evidence for academic institutions classroom monitoring for sustainable development in educational system.

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