Moving towards motion activated security camera system with live feed and call routing

F. O. Okorodudu

Department of Computer Science, Faculty of Science, Delta State University, Abraka, Nigeria.
E-mail: okoroblackx4@yahoo.co.uk

Accepted date

Due to increased crime rate, cities all over the world are installing cameras in strategic areas for surveillance reasons to monitor human activities for security purposes. An important surveillance application is to track the motion of an object of interest using cameras and send the motion path through video feeds and also routing a call to control centres while maximizing device storage for object and motions captured using raspberry pi. This article proposes a motion activated security camera system with live feed and call routing that requires least user input. Given approximate corresponding points between locations identified by a user, the process computes the point of reference and position of the camera and determines the position in the camera view. Simulation of various electronic components used was carried out using the procedural programming language C. The performance method is assessed. A digital signal from the sensor circuits will trigger the circuit to produce an alarm. It was found out that the output of the study is accurate in terms of detecting moving objects with body temperature at all times. Results from the design also show that the device has a good performance and suitable in terms of functionality. Application of this designed model would go a long way to cut crime rate in the society.

Key words: Security, closed-circuit television (CCTV), live feed, call routing, wireless networks raspberry PI.

INTRODUCTION

Many businesses, government's agencies, schools and even homes, are moving towards video surveillance system. Correctional centers, casino, banks and airports are not left out in ensuring public security.

With the increase of economical cameras and the accessibility of high-speed, broad-band wireless networks, deploying a huge number of cameras for security surveillance has become economically and technically feasible (Rangaswami et al., 2003). Theft of valuable objects is some of the never-ending problem in the world. Quite a few detecting devices exist in the market today. Instance of such is to grant an alarm which can be activated using a remote control.

Unfortunately, these devices had no terms to repeatedly detect theft attempts by the owner. Moreover, security gadget using alarms are expensive. Other known devices prompt an alarm, if motion sensing device detects movement of a confined object. Contrasting the devices based on separation distance, motion sensing devices react to an attempted theft immediately when the confined article is moved, and these motion sensing devices are prone to fake alarms because they do not discern motion caused by the possessor or an innocent passerby in a busy environment from motion caused by a theft.

There residue a must for a theft restriction system that is suitable in use, comparatively free from false alarms and does not need common user action to activate and deactivate the system (D'Angelo et al., 2000). A device with a high sensitivity in sensing body temperature is appropriate for use in protecting business establishments and homes (Alexan and Mahdy, 2014). The mission of motion detector is to detect an area of interest, personified in a region of responsiveness, where the region of responsiveness, or related with the focus of the

camera in the field of view, is defined as the piece of environment being experimental. The area of interest is in the piece of the environment where action is monitored.

Area of significance can be an animal, a person, or an object without body temperature that is circumscribed with the moving objects (Gachter, 2001). Security, application of know-how and innovating cheap existing anti-theft equipment are some of the basis why the researcher came up with this study. Related works has shown that, motion detection coupled with switching circuits for the purpose of security were of great importance to this work. This will also serve as the channel for the improvement of a device against theft in maximizing body temperature and motion detection whose act is satisfactory in terms of simplicity, availability, functionality, cost and operation.

LITERATURE REVIEW

Related work on surveillance systems

In recent past, the closed-circuit television (CCTV) systems as a means of surveillance have dominated the security industry.

However, given the contentious nature of CCTV, amazingly little is known regarding how it is managed and how efficient it is in achieving countless stated aims. CCTV has a number of possible applications for civic protection, and has been launched with the goal of preventing crime, detecting offences, improving the answers to emergencies, supporting management of places and alleviating civic fear of crime (Ratcliffe, 2011).

CCTV is used to checkmate the inflow of passengers in transportation companies, investigating complaints which are against facilities and staff (National Rail CCTV Steering Group, 2010). Almost all research concentration to date, has its attention in employing CCTV to check crime because of its potential applications (Honovich, 2008). Mayhew et al. (1979). Reducing crime at the London subversive station CCTV was effective, although the assessment methods used had a number of short comings Webb and Laycock (1992). Since then, the focus has received considerable research awareness with diverse empirical results. For instance, numerous assessment have found CCTV to be helpful at sinking thefts in parking lots (Poyner and Webb, 1987) however, others have revealed it to have tiny or no impact on crime in residential environment (Gill and Spriggs, 2005). A systematic assessment by Welsh and Farrington (2008) of about 41 studies fulfilled that CCTV is helpful at preventing several types of crime in some situations, but that the facts suggests it has a more-limited impact than its prevalent operation may advocate.

In disparity to the widespread literature on the significance of CCTV for crime avoidance, there is a slight research on how constructive cameras are for additional reasons. Ditton and Short (1998) established to facilitate the 2 years following the setting up of a CCTV device in a Scottish township, the percentage of crimes that were quell by police amplified from 50 to 58%, with little offences showing better increases than others.

However, no piece information was given regarding whether these changes were of statistical significant, and charge were only provided for a few types of crime (the principal hub of the study was on crime avoidance). In Australia, Wells et al. (2006) opined that the implementation of CCTV camera brought huge result in two suburbs when monitored little number of arrest of defaulter at the crime scene, but did not take recording seriously during investigations.

Limited proof can be established in exploring on solvability factors: the features of an offence that verify the probability of the case being solved. For non-housing break-in, Coupe and Kaur (2005) found that CCTV being installed in a building was linked with twice the rate of detections compared to other buildings, motivated by the improved availability of suspect descriptions. Since this study used information's from the year 2000, it is likely that developments in technology may possibly have influenced the efficiency of CCTV in solving this type of crime. For instance, modern cameras are expected to provide higher-resolution images, and digital (as compared to tape-based) storage space allows images to be stored longer (Taylor and Gill,

2014). Existing study on solvability factors is restricted because; it is largely focused on the investigation of a lone crime type (burglary).

Levesley and Martin (2005) supposed that CCTV was a useful analytical instrument. A report on the significance of CCTV commissioned by Dyfed-Powys Police in Wales argued that, cameras were helpful in the revealing of crime, citing the opinions of police investigators and local prosecutors.

However, the report also suggested that, live-monitoring of CCTV cease because it was useless at preventing crime or improving the initial answers to incidents. Quite a few municipalities in Britain have reduced their investment in CCTV in reaction to recent budget cuts. Overall, some appears to be known about how the value of CCTV for investigation varies across crime types, which is expected to be significant in any attempts to make CCTV more useful. The present investigative study attempted to offer some facts in these areas.

Visual information acquisition

An image or a video, if digitized is represented by a number of frames per unit of time, with each frame in turn represented by a number of components (three colours or more), each again represented by a set of pixels at a given precision (8 or more bits), scanning the frame component on a raster, line by line.

This is often known as first general representation and was introduced taking into account practical issues such as camera and scan technologies, as well as simplicity of their representation. First generation image and video can be represented as one or more matrices whose elements correspond to a frame's component pixel. When compared to the first, second generation representation approach represents image and video as set of what is called attributes. A principally popular second general representation is that of object-based representation where to each object has been assigned some colour, texture or motion attributes (Ebrahimi, 2004). The best part of image and video segmentation techniques try to take a first general image or video as an input and present as output a second-generation representation of them. Other image and video analysis tools remove other and offer what one generally calls a content-based symbol in form of edges, features points, and others.

Video surveillance systems

Video surveillance systems are dynamic area of research. Object detection and tracking, in video surveillance systems are generally based on background estimation a subtraction. The main hub of today's video surveillance systems act is the application of video compression technology to professionally multiplex or store images from a huge number of cameras onto mass store devices (video tapes, discs) (Bojkovi et al., 2005). From the perspective of real-time threat detection, it is well known that human visual attention drops below acceptance levels, even when trained personal and assigned to the task of visual monitoring (Rao et al., 2002). On the other side, video analysis technologies can be applied to build smart surveillance systems that can assist the human operator in real-time threat detection (Araki et al., 2001). Specifically, multiscale tracking technologies are the next step in applying automatic video analysis to surveillance systems.

A typical visual surveillance system application includes human activity surveillance and unusual activity detection, which also include pedestrian traffic monitoring. This application consists of three important building blocks which are motion detection, higher level motion analysis and object tracking. Events of interest recognized as moving object and people have to be synchronized in the multi-view system and events of unique interest have to be tracked all through the scene (Rao et al, 2005). Numerous video surveillance products are obtainable on the marketplace for office and home security as well as isolated surveillance.

The device monitors a home, an office, or any location of curiosity, capturing motion events using webcams or camcorders and detects abnormalities (Haritaoglu, 2000). In the case of webcams, the image data is stored into uncompressed or compressed video clips, and the system triggers various alerts such as sending an e-mail. The necessity of working with multifaceted

scenes characterized by high variability, demands the use of exact and sophisticated algorithms for video possession, camera calibration, noise filtering and motion detection that are able to learn and adopt to changing scene. Working with scenes characterized via poor structure demands the use of robust pattern recognition and statistical methods.

Video system for urban surveillance

The system incorporates the task of object detection, tracking, recognition and classification. The dilemma of object detection has been tackled using statistical models of the background image (Boult et al., 2001), frame differences techniques or a mixture of both (Collins et al., 2000). Several techniques have also been applied for object monitoring in video sequences in order to manage with several interacting targets.

Object recognition and classification is performed using statistical Pattern Recognition and neural network. Several features, which explore the specific condition of the problem, can be used. These include geometric features such as bounding box aspect ratio, motion patterns and colour histogram (Mckenna et al., 2000).

Visual data processing at sensor level

The sequences acquired by video sensors during image processing can be prearranged in quite a lot of abstraction layers, ranging from the low-level processing routines in which each image is considered as a group of pixels and fundamental features need to be extracted (for example: image edges, moving objects etc.) up to the peak abstraction stage in which semantic labels are connected to images and parts of images in order to give an evocative description of the actions, events and behaviours detected in the monitored scene.

Even though the lowest processing level has been widely studied since the creation of computer vision research, it is still affected by many open problems; actually, it is common belief that the major limitations for high-level techniques is the lack of proper low-level algorithms for robust feature extraction. One of the most common low-level problems consists in the detection of moving objects within the scene observed by the sensor, a problem often referred to with the terms change detection, motion detection or background/foreground segmentation. The basic idea is to compare the up to date frame with the previous ones in order to detect changes, but several problems must be faced, for example:

i) Camouflage effects are caused by moving objects similar in appearance to the background (changes in the scene do not mean changes in the image)
ii) Light changes can pilot to changes in the images that are not related to real foreground objects (changes in the image do not mean changes in the scene
iii) Foreground aperture is a dilemma affecting the detection of moving objects with consistent appearance, so that motion can be detected only on the borders of the object
iv) ghosting refers to the detection of false objects due to motion of elements initially considered as a part of the background Change detection algorithms can be generally classified in two main categories, depending on the elements which are compared in order to detect changes:
v) Frame-by-frame algorithms
vi) Frame-background algorithms (with mentioned background image or with background models).

Initially, searching for changes within two or more adjacent frames must be detected in the video sequences (Carincotte et al., 2006): if Ft(x, y) is a frame at time t, the change detection image

D(x, y) is defined as: D(x, y) = |Ft(x, y) ? Ft?1(x, y)| (1)

This technique is typically robust to ghosting effects, but it is generally affected by foreground aperture problems, since two frames both containing the moving object are compared. Frame-background algorithms instead rely on a model representing the background scene without any moving object, and each frame is compared

to the model. Background models can be simple images or more complex models containing for example statistical information on the temporal evolution of each background pixel. When using background images, let Bt(x, y) be a background frame at time t, objects can be detected by image difference:

$$D(x, y) = |Ft(x, y) ? Bt(x, y)| \quad (2)$$

or by more complex image comparison techniques, such as Normalized Cross-Correlation (Tsai and Lin, 2003). The background image also needs to be continuously updated in order to reveal small changes in the background form, for example due to slow light changes in outdoor environments. A typical approach is to apply a running average with exponential forgetting to each pixel value; this is the mean of the measured pixel values by giving more weight to the more recent measures (Wang et al., 2002). More complex background models can also be used; it is the case of the popular mixture-of-Gaussian background model proposed by Stauffer and Grimson (2000) in which each pixel of the scene is represented by a mixture of several Gaussians, in order to give a proper statistical model for those pixels with multimodal appearance. The system has the ability to route calls to designated number when an object or motion is detected, which also store data only when it is required for memory management and to work on a very little energy, it differ from the CCTV camera system that store data continuously and this occupy memory space of the system. With the promptness of the system, the attention of policemen can be called upon to save lives and properties.

METHODOLOGY

This study involved the design and implementation of a motion activated security camera with live feed routing technique. The study involved writing a C programme and running python and then bringing them to run under the same program by using open series algorithm to track objects. The new system is such that the camera module is interfaced with the raspberry PI. The raspberry PI is a single board computer running Linux operating system.

When power is transmitted to the system, the raspberry PI loads its operating system (Raspbian OSLinux based) from the SD card into its main memory. When the OS is fully loaded the system initializes the camera and it automatically start the motion detection software, when a person walked across the camera the software starts taking photos and the photos will be uploaded to a Gmail account The new system is made up of different part which makes up the overall system design. Figure 1 shows the block diagram of how information flows from one component to another, which activate all the sensors for information processing. The system has as the major parts, the following:

(i) The Raspberry PI
(ii) The Camera
(iii) The PIR module
(iv) The Microcontroller module
(v) The power supply module
(vi) The GSM module

The PIR module SB612A in Figures 1 and 2 is a pyroelectric sensor module developed for human body detection. It is an integrated PIR sensor combined with a Fresnellens that a compact PCB, and limited components to form the module. This works with the body temperature (Figure 3).

RESULTS AND DISCUSSION

Detecting a motion triggers the camera on Figure 4 shows the result of intruders, by storing and streaming same to the user for necessary action. Figure 5 shows the result of live streaming to a Gmail account of the user whereby it can view whatever is going on within the environment. The DC voltage contains some ripples which is then filter out by the electrolytic capacitor, 16v by 2200uF or 25v by 2200uF. At this stage, a pure or partially pure DC voltage is obtained. Theoretically, the dc voltage obtained is 25v since the capacitor charge up to 25v. Positive terminal of the capacitor is connected to one end

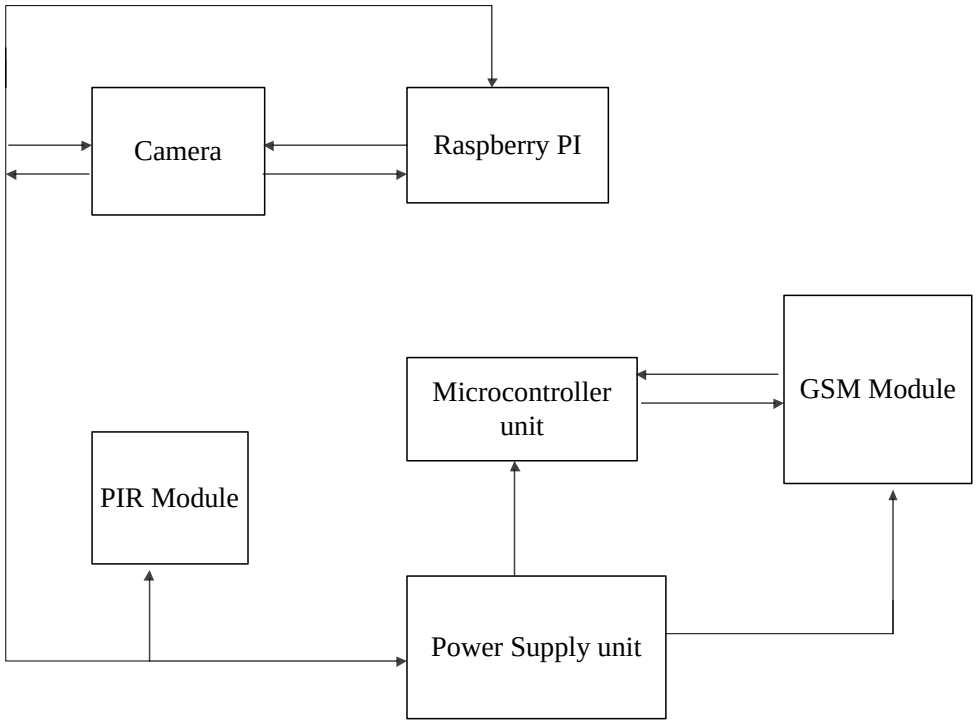

Figure 1. Block diagram of the motion activated camera detection system.

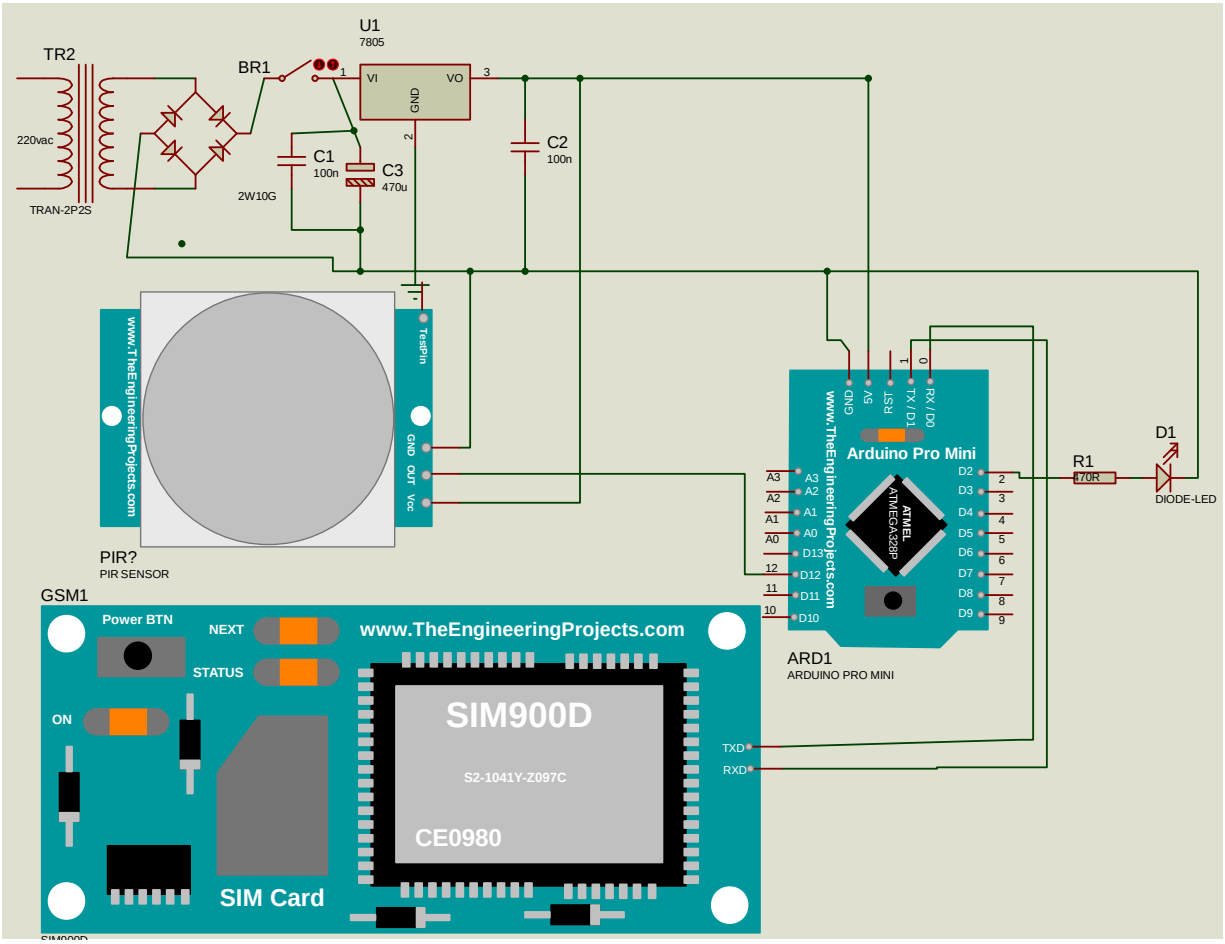

Figure 2. Motion detection circuit.

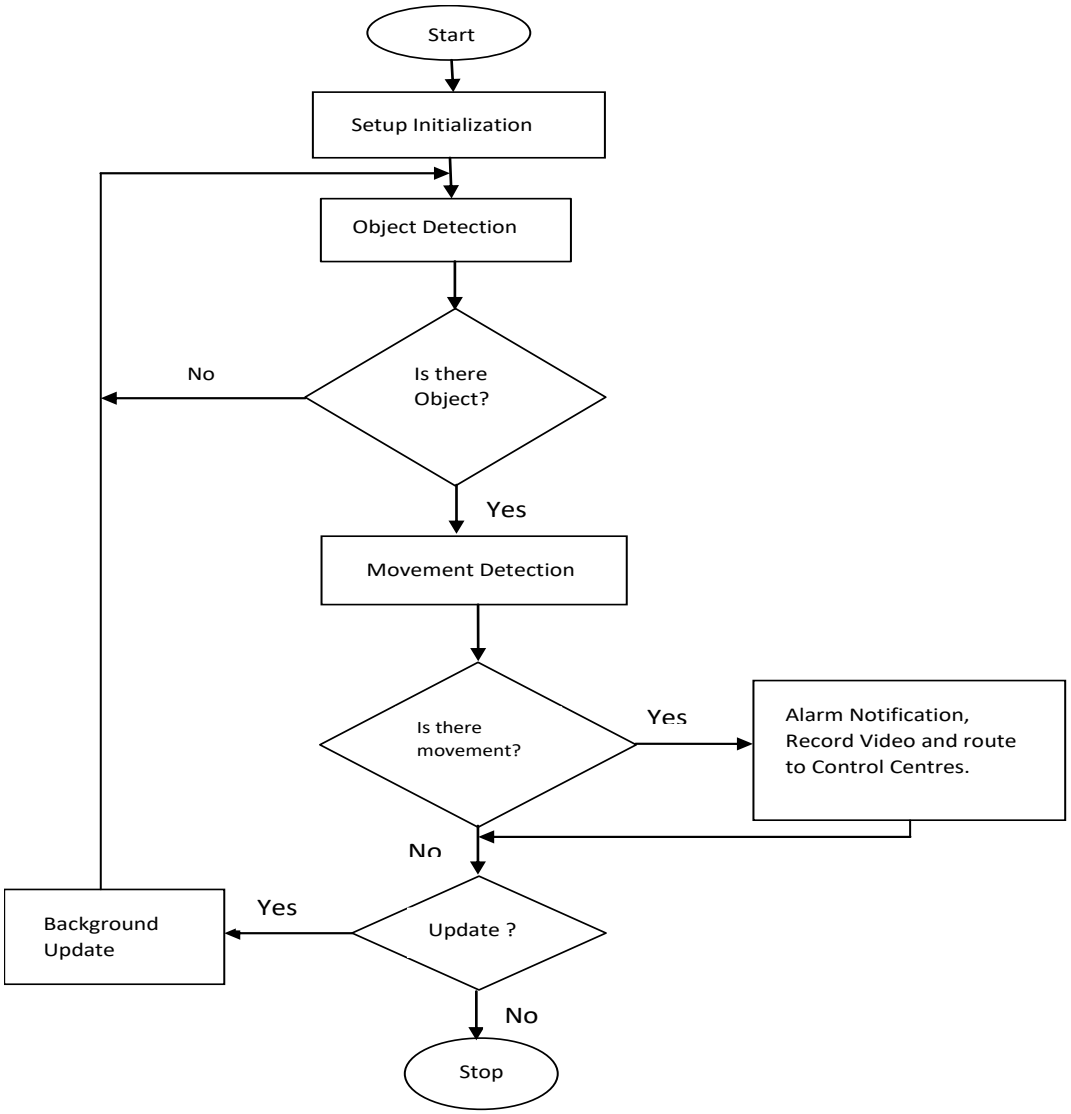

Figure 3. Flow chart for the designed system.

of the relay coil and its negative terminal is linked to the sensing wire on the microprocessor and return back to the relay (Figure 6).

For the Raspberry PI, when the system is powered ON for the first time, it loads the operating system from the memory card to the main memory. If the system is fully initialized, it automatically loads the PI camera program to its main memory. Figure 8, it connects to a wireless network which is available and assigns an IP address.

The IP address is now used by just tying it and
pressing the enter key which now navigates to create a web server which is seen from selecting the camera folder. Clicking on the camera will load a page where we have the live feed Figure 5 for example, IP camera, live detection followed by some other controls. From there, you click on the web page of motion detection start from it. Some other controls exist on the folder where one can get the videos that motion has been captured. The Raspberry PI detects motion from the camera and analyzes pixel by pixel the change in the environment. If for instance, one puts his hand in the front of his phone, the raspberry PI takes the picture and compares it with other pictures in the system to show that there is motion. Once there is a variation in the pictures taken, it sends it to the

Figure 4. Showing object and motion result from the camera.

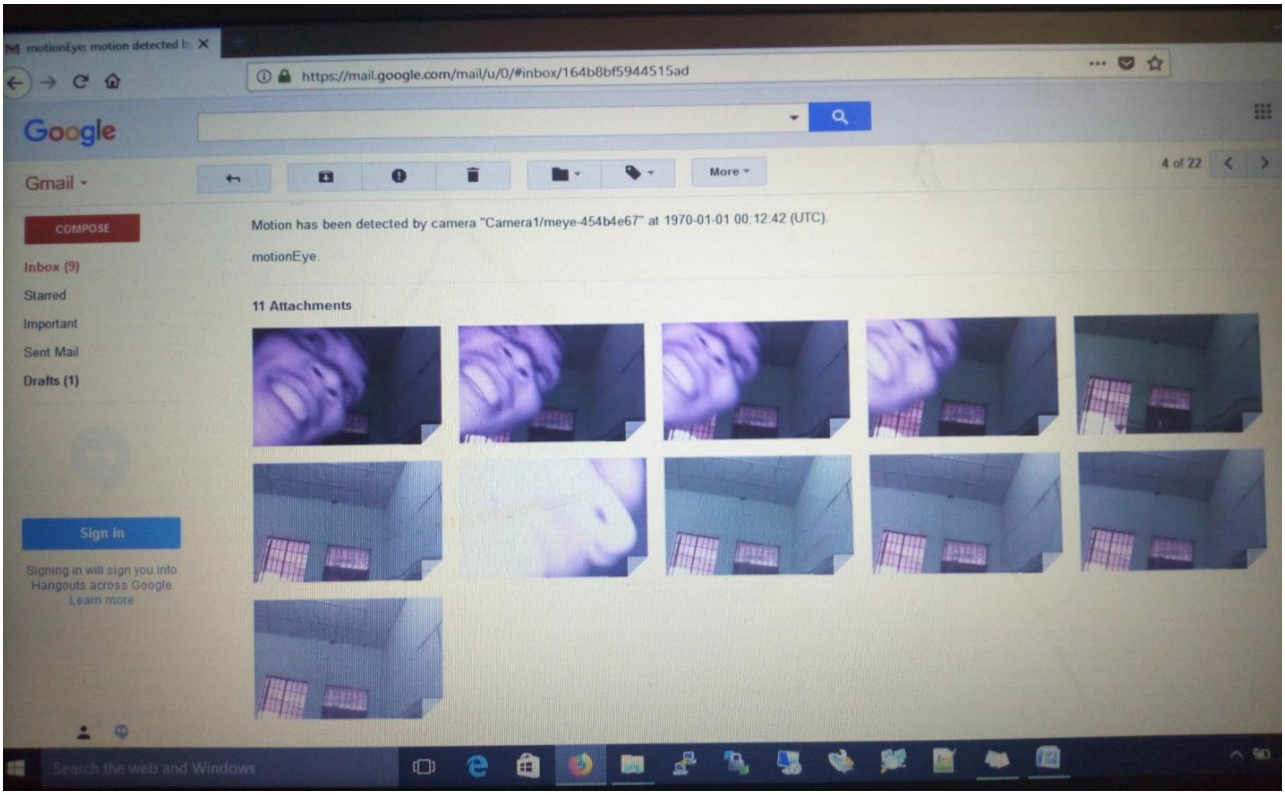

Figure 5. Live feed on Gmail account.

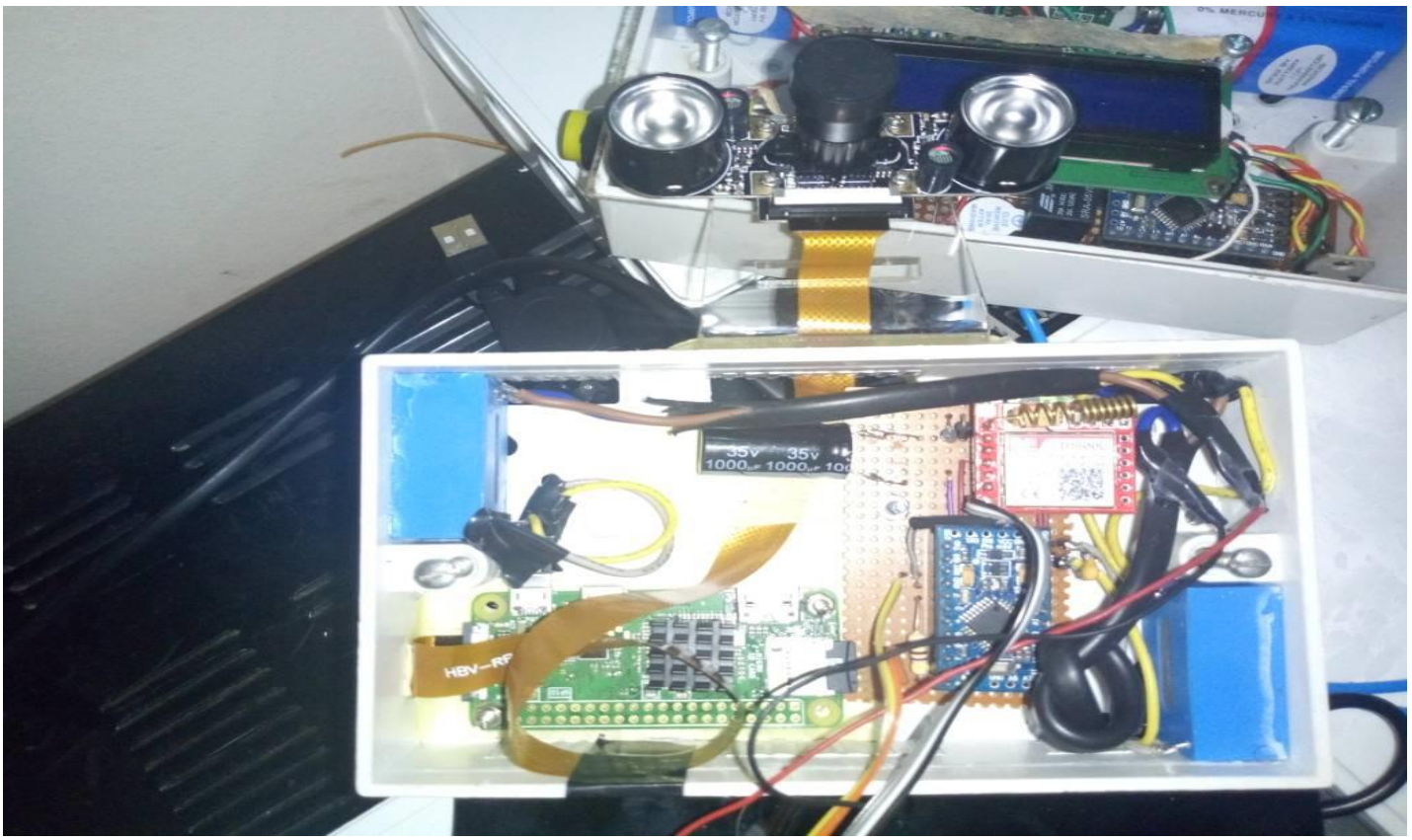

Figure 6. Diagram showing the inner circuitry of the designed system.

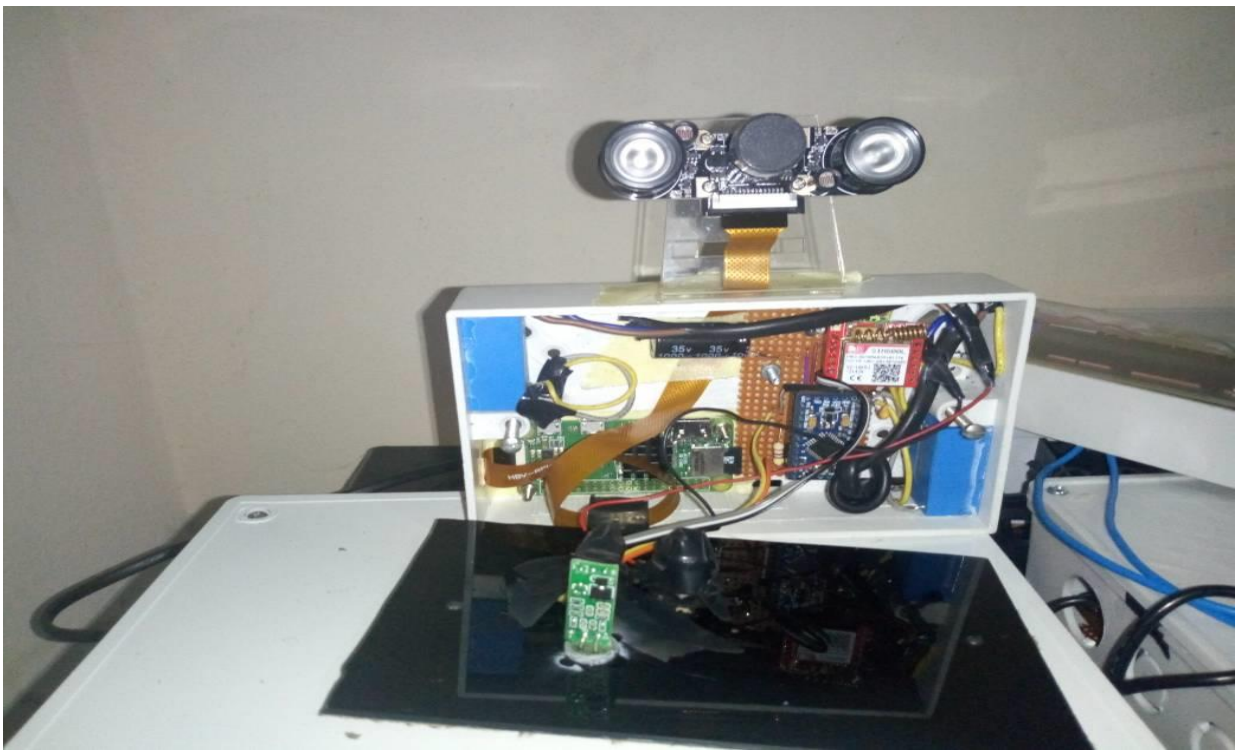

Figure 7. Diagram showing the complete system before covering.

Figure 8. Open source configuration for motion activated camera.

GSM as a text message (Figure 7). For the motion detection part, when power is transmitted to the microcontroller through the 5 volts power supply, the microcontroller initializes the GSM module. Secondly, it initializes the motion detection module which usually takes time to get the temperature of the environment. When motion is sensed, once there

is a change in the infrared background in which case there is a variation in the temperature in the background which the device will detect in the infrared spectrum, a signal will be sent to the microcontroller signaling the microcontroller that there is an intruder around. Due to the motion detected, the microcontroller will send a command to the GSM module, that initialize and call a predefined number and send messages to the predefined number at the same time.

The system is flexible and requires only 12 volts power supply to function properly. The system requires very little energy to work. Figure 8 depict the new system is wireless as it is IP based. The system is a self-contained computer which can run multiple process at the same time
allowing for the addition of up to four cameras while one can still be working on word document in the system. The designed system has an inbuilt night vision which can be used at night based on the infrared which has to external infrared illumination that can be used at night.

The system is a motion activated security camera system with live feed routing. It is typically positioned near exterior doorways or windows of a building to monitor the area around it. Since motion detectors are so supple and have countless uses, it offers a mind-set of protection and security for a typical home owners as well as profit-making organizations. The motion activated security camera detector is a piece of equipment used to detect any physical movement in a given neighborhood and transforms motion into an electric signal. It consists of sensor that is electrically linked to other devices such as security system, audio alarms, lighting, and other applications. Motion sensors are used in a wide variety of applications and as a result, numerous types of motion sensors including the infrared sensor are obtainable.

Infrared sensors are extensively known in the arts of intrusion detection and in fire or smoke detection. It is a device that is often used in automatic light switches and security systems to turn on a light or to activate some other form of alarm or warning indicator when a person enters a monitored area. The infrared sensors have basically two forms: active and passive. The proposed active infrared method of motion detection has the benefit of fast speed response of a comparatively large sensor. This benefit permits simpler optical system design, mainly for wide fields of view. Besides, it is insensitive to mechanical and acoustic noise, which presents substantial problems in the passive infrared (PIR) sensors.

Low production cost is another advantage of these active infrared detectors. When a moving human body enters the detection zone, the sensor generates a high signal. The emitted infrared radiation is sent from the human body is to the PIR sensor's receiver. Human detection systems are in demand for various applications such as automatic doors, security systems, medical purposes, surveillance and civil applications.

Conclusion

This research study described security camera system with call routing. The paper explores advances in electronic technologies using microcontrollers and sensors which offer a great variety of new and inexpensive sensing, monitoring and control potentials. The open-source hardware Arduino development platform was exploited for the sensors. The main advantage of the security camera detection systems includes its ability to be used for 24 h uninterrupted and working with minimal energy.

Using technologies can affect people's behaviour in many ways, when they discover that before they could perpetuate the acts of stealing, response teams are already there, right there and then they will understand that there is an eye watching them which will make them to stop the act for the fear of the unknown.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Alexan, W. and Mahdy, A.(2014). "A quantized reliability-relay selection

for wireless cooperative communications" 11th International Symposium on Wireless Communications Systems (ISWCS) by IEEE, Barcelonia Spain. pp. 318-322

Araki, A., Matsuoka, T., Yokoya, N. and Takemura, H. (2001). "Real-Time Tracking of Multiple Moving Object Contours in a Moving Camera Image Sequence", Institute of Electronics, Information and communication Engineers (IEICE) Transaction on Information and System, Japan. vol. E83-D, no. 7, pp. 1583–1591.

Bojkovič, Z., Samčovič, A. and Turán, T. (2005). "Object Detection and Tracking in Video Surveillance Systems", COST 276 Workshop, Trondheim, Norvegia, pp. 113–116.

Boult, T. Micheals R.J, and Gao X. (2001). "Into the Woods: Visual Surveillance of Noncooperative and Camouflaged Targets in Complex Outdoor Settings", in Proceeding of the IEEE ieeexplore, vol. 89, no. 10

Carincotte, C., Derrode, S., & Bourennane, S. (2006). Unsupervised change detection on SAR images using fuzzy hidden Markov chains. IEEE Transactions on Geoscience and Remote Sensing, Vol. 44, no 2, Pp 432-441, Retrieved February 6, 2021 from https://doi.org/10.1109/TGRS.2005.861007

Collins, R. Lipton A.,Kanade, T.and Fujiyoshi H. (2000). "A System for Video Surveillance and Monitoring", Institute at Carnegie Mellon University (CMU), The Sarnoff Corporation, Princeton, NJ.

Coupe T. and Kaur S. (2005). "Role of Alarms and CCTV in Detecting Non-Residential Burglary" *Security Journal* Vol 18 Issue: 2 2005 Pp: 53-72, Retrieved January 21, 2021, from https://doi.org/10.1057/palgrave.sj.8340198;

D'Angelo, M., Eggert G., Bresler R and Qualitz, J. (2000). Motion sensitive anti-theft device with alarm screening, Invention with patent number US 6133830 A, United States of America

Ditton, J. and Short, E. (1998). Evaluating Scotland's first town centre CCTV scheme. In C. Norris, J. Moran & G. Armstrong (Eds.) *Surveillance, closed circuit television and social control*, (pp. 155–173). Aldershot: Ashgate.

Ebrahimi, T. (2004). "Image and Video Analysis: Trend and Challenges Position Statement", VIAMIS, Lisbon.

Gächter, S. (2001). Motion Detection as an Application for the Omnidirectional Camera OMNIVIEWS – Omni-directional Visual System. Technical Report CTU-CMP-2001-03, Centre for Machine Perception, Czech Technical University in Prague, 2001.

Gill, M., and Spriggs, A. (2005). Assessing the impact of CCTV, Home Office Research Study 292, February, retrieved march 2, 2021 from http://www.homeoffice.gov.uk/rds/pdfs05/rdsolr1505.pdf.

Haritaoglu, H. (2000). "Hartwood and Devis, W4: Real Time Surveillance of People and their Activities", *IEEE Trans. Pattern Anal. Machine Intell.*, vol. 22, no. 8, pp. 809–830.

Honovich, J. (2008). Is Public CCTV Effective? Retrieved April 15, 2021, from *http://ipvm.com/reports/is-public-cctv-effective*

Levesley T. and Martin A. (2005). Police attitudes to and use of CCTV; Home Office Online Report 09/ 05, Great Britain Home Office Research Development and Statistics Directorate Room 201, 50 Queen Anne's Gate, London, SW1H 9AT England, United Kingdom

Mayhew, P., Clarke, R.V., Burrows, J.N., Hough, J.M. and Winchester, S.W. (1979). *Crime in public view. Home Office Research Studies series*. Great Britain Home Office 50 Queen Anne's

Gate, London. SW1H 9AT England, United Kingdom

Mckenna, S., Jabr S., Duric, Z and Rosenfeld, A., (2000.). "Tracking Groups of People",Computer Vision and Image Understanding Vol 80 Issue 1, pp. 42–56,

National Rail CCTV Steering Group. (2010). *National rail and underground closed-circuit television (CCTV) guidance document*. London: Association of Train Operating Companies. United Kingdom

Poyner, B., and Webb, B. (1987). *Successful Crime Prevention Case Studies*. London: The Tavistock Institute of Human Relations Document No. 2T 563. London: United Kingdom

Rangaswami, R., Dimitrijevic, Z., Kakligian, K., Chang, E. and Wang, Y. F. (2003). "The SfinX Video Surveillance System". A proceeding on IEEE conference on Multimedia and Expo

Rao, K. R., Bojkovič, Z. S. and Milovanovič, D. A. (2002). "Multimedia Communication Systems: Techniques, Standards and Networks", Prentice-Hall PTR, New Jersey.

Rao, K. R., Bojkovič, Z. S. and Milovanovič, D. A. (2005). "Introduction to Multimedia Communications: Applications, Middleware, Networking", Wiley.

Ratcliffe, J.H. (2011). *Video surveillance of public places. Problem-Oriented Guides for Police Response Guides Series*. Washington: DC: Center for Problem-Oriented Policing.

Stauffer, C and Grimson, W.E.L. (2000). "Learning patterns of activity using real-time tracking". *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol 22 No 8 Pp747–757.

Taylor, E., and Gill, M. (2014). CCTV: reflections on its use, abuse and effectiveness. In Gill, M. (Ed.), *The handbook of security* (Chap. 31, pp. 705–726). Palgrave Macmillan, London

Tsai, D.; Lin, C. (2003). "Fast normalized cross correlation for defect detection". Pattern Recognition Letters, Elsevier B.V. 2003, Vol 24, no 15, 2625–2631.

Wang, D.; Feng, T.; Shum, H. and Ma, S. (2002). "A novel probability model for background maintenance and subtraction". In Proceedings of the 15th International Conference on Vision Interface. Calgari, Canada, 2002, pp. 109–117.

Webb, B., and Laycock, G. (1992). Reducing crime on the London Underground: an evaluation of three pilot projects. Crime Prevention Unit Papers series. London: Home Office.

Wells, H.A., Allard, T. and Wilson, P. (2006). Crime and CCTV in Australia: understanding the relationship. Humanities and Social Sciences Papers series. Gold Goast: Bond University.

Welsh, B.P. and Farrington, D.C. (2008). Effects of closed circuit television surveillance on crime. Campbell Systematic Reviews 2008:17, DOI: 10.4073/csr.2008.17 Cambridge, CB3 9DT United Kingdom