COMPUTER VISION TO DETECT DRIVING DISTRACTION USING HISTOGRAM ORIENTED GRADIENT (HOG)

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Abstract

Road accidents in Nigeria and all over the world have been a major problem for a very long time. Thousands lose their lives and millions of people lose a livelihood annually because of road accidents. Fatigue, which causes drowsiness among other factors, is a key contributor to road accidents. This study aimed at making use of the available technologies to detect distraction among drivers at early stage in order to prevent or reduce the impact associated with accident, this is achieved by warning the driver of his or her state when driving. Agile development is adopted in the development of the final product that targeted embedded devices. The final product regist9+ered good system performance with up to 65% drowsy cases detected by the system.

Keywords: *Fatigue, road accident, livelihood, drowsiness, detects distraction, agile development, and embedded devices.*

1. INTRODUCTION

Passenger safety has been a major concern to all societies in any country in the world. Thousands lose their lives daily and many more lose their livelihood because of paralysis caused by accidents. On average traffic, road accidents in the world claim 13 million lives and cause 20 to 50 million disabilities annually (Manyara, 2013). It is approximated that road accidents account for more than 23% of all injury deaths worldwide. This statistics are projected to rise to be the third killer by 2020 (Manyara, 2013) ahead of HIV/AIDS, respiratory infections and wars (Nantulya V.M, 2012).

Developing countries shoulder the largest share of road accidents despite having the smallest share of all registered vehicles. With only 52% of the worlds registered vehicles, they account for over 80% of all world traffic accidents (Manyara, 2013). Currently the annual road traffic fatality rate stands at 20.1

per 100,000 compared to 8.7 per 100,000 in the high income countries (WHO, 2012).

According to Federal Road Safety Crops (FRSC), there are about 20,000 of the 11.654 million vehicles involved in accidents caused by distraction every year in Nigeria, making Nigeria one of the countries with the highest number of fatalities in Africa. The situation is especially problematic in Nigeria because of poor traffic infrastructure, poor road design, poor enforcement of traffic rules and regulations, a rapidly growing population, and subsequent number of people driving cars. As Nigeria's economy grows, the volume of traffic is expected to rise from 8 million vehicles in 2013-2040 million by 2020 (Driving in Nigeria, Time for test, 2013). The recent development of super highways has not saved the situation as the accidents continue to increase.

According to Manyara (2013), the researcher attributes 85.5% of road accidents in the country to poor driver behavior. From this, distraction cause over 87% of the road traffic accidents associated with poor driving behavior (G. Munala, 2012) and (Manyara, 2013).

In order to counter distraction several measure have been put in place for tracks, public service vehicle (PSV) and private vehicle drivers.

Drivers driving under immense pressure, stress, drowsiness, phone calls, eyes drifting from the road, drunk driving, driving after taking medicines, reckless driving and those who drive longer for economic reasons contribute greatly to these statistics.

Distraction reduces the concentration, activeness, alertness and vigilance of the driver and it make the driver to take slow decision and sometimes no decision.

Distraction affects the mental alertness and decreasing the driver ability to operate a vehicle safely and increasing the risk of human error that could lead to fatalities and injuries.

Driver distraction is difficult to control especially in cases where drivers are reluctant to accept their mental state. This is most prevalent when they are under pressure to perform.Establishing the mental state of a driver can help prevent the losses by warning the driver of his or her state, an alert can also be sent to the freight managers. A solution to this problem is to identify when the driver is distracted and alarming the driver/passengers of the situation so that road safety can be increased.

2. PROBLEM STATEMENT

Road accidents are nowadays very common in the country and this is due to lack of early detection and lack of specialized system to identify driver's lack of concentration when driving. In Nigeria, driver drowsiness especially among long distance truck drivers, public service vehicles drivers and private vehicle

drivers is a major concern. This continues despite the government putting in place several measures to address the problem; measures including regulation of the public vehicle travel time, increasing the number of drivers for buses that travel at night, use of alcohol blows to detect drunk drivers among many others. Providing distraction detection system among drivers has not been achieved making it difficult to enforce relevant legislations. A few systems are available in the market however; they are expensive making them a reserve for a few who can afford the cost of the current vehicles fitted with search technologies. There is hence great need to provide distraction detection system that are affordable to the many who are low income earners and also public service vehicles to help address the many accidents associated with distraction.

3. AIM AND OBJECTIVES OF RESEARCH

This study aims at collecting distraction symptoms from the driver's face through analysis of the driver's eye state. This will be achieved through processing video images obtained through a sensing technology.
The outcome of the video will be used to determine the distraction levels and then provide a warning to the driver if he or she is distracted.
The objectives are as follows;
1. To be able to accurately detect face from an image.
2. To provide a warning to drivers if distraction is detected.
3. To accurately classify the state of the eye either closed or open.
4. To be able to detect the region of interest in this case the eye.

4.SYSTEM ANALYSIS AND DESIGN

Agile development was adopted. This approach combined both the Python programming language and scrum methodologies to achieve the desired objectives. The researcher aimed at tapping into the strength from the extreme programming especially program refactoring and combining the scrum capabilities in order to overcome the different challenges found in embedded environment.

4.1 REQUIREMENT ANALYSIS

In order to develop the specific system that will operate in the target environment and meet the specific objectives requirement analysis was conducted. Through observation of the driver behaviours coupled with the research conducted by other researchers in the same and related area a lot of information was obtained.

4.1.1 ARCHITECTURAL MODEL

The new system is distraction detection system for automobile. Driver distraction will be determined from several symptoms that manifest in distracted driver's face. Through analysis of the eye states, the system will be able to tell a drowsy driver from a normal driver. A video stream will be continuously obtained from the driver's faces and feed into a microcontroller for processing. Classifiers will then be used to classify the state of the driver's eye. If a drowsy driver is detected an alarm will be raised, until the system notices the driver is alert.

Development of the system was through agile methodology where the scrum and the python programming language were combined. The system was broken into small modules, these modules were developed independently and tested integration was done. During unit, testing refactoring was adopted in order to optimize the units for their intended purpose.

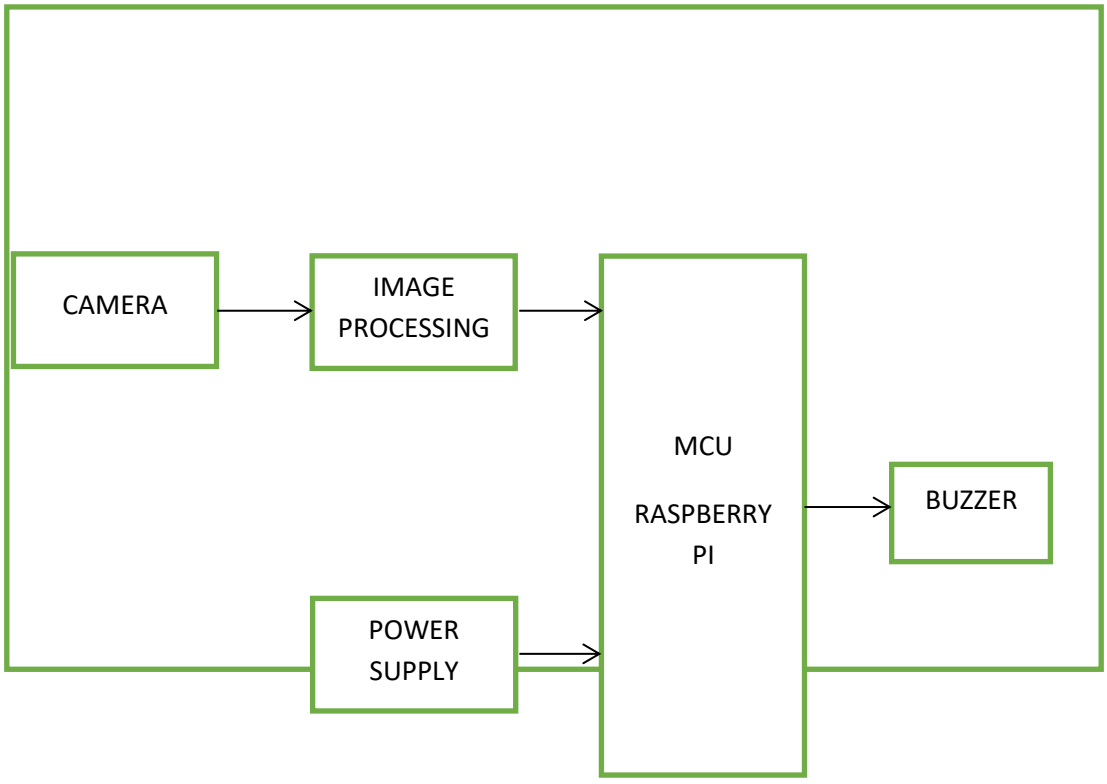

Figure 1:The above showed the Architecture of the proposed system

The system stem is made up of an aggregate of several components that are interlinked to produce the final artefact as illustrated by the figure below.

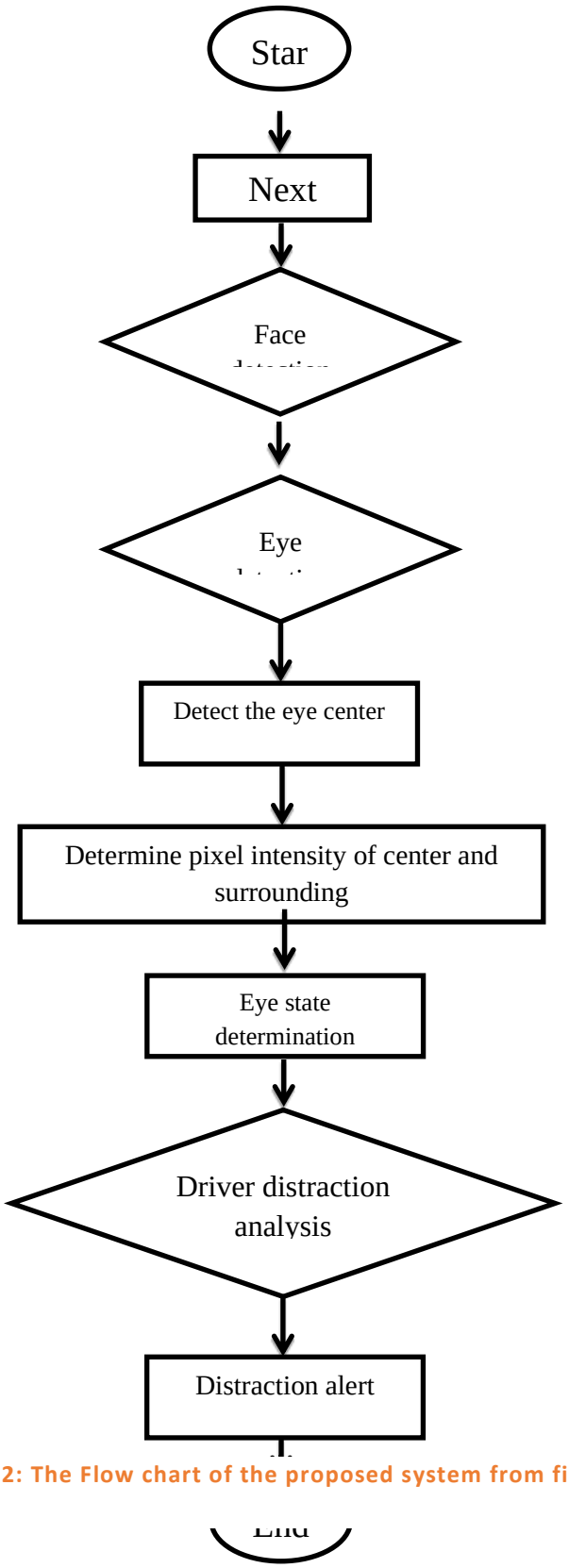

Figure 2: The Flow chart of the proposed system from field.

4.2 ALGORITHM OPTIMIZATION

In order to optimize the algorithm that is used in computer vision to detect driving distraction. Haar cascade classifiers were only used in face and eye detection, this uses integral images hence reducing the number of computations to be performed on an image, Ada boosting and the adoption of a cascade classifier increases the performance and reduces the search area. This is because the weak classifier eliminates the unnecessary regions in the image.

A new approach for detecting the eye state was adopted over a classifier, which would have been both computational and memory expensive for the system. The method as proposed by (Mehdy Bohol n.d.) On his research on computer vision syndrome prevention research proved to be a less expensive on the available resources. The method adopted aimed at computing the pixel intensity of the central part of the Region of interest and testing the pixel intensity difference with the surrounding regions. A threshold value is established and the pixel value of the region obtained is tested against in threshold in order to make a decision whether the eye was closed or not.

4.2.1 SYSTEM IMPLEMENTATION

Our system uses an algorithm to locate, track, and analyze both the driver's face and eyes.

A distraction detection system based on the above method was implemented by using Python. At first, we fix a camera on a car in front of the driver. Then the webcam capture some videos from drivers in normal conditions. The whole input image format is 320×240 and they are in RGB color space. The optimum distance from camera which obtained about 30cm-50cm is very suitable to capture the face of the driver. The system works best on good lightening condition.

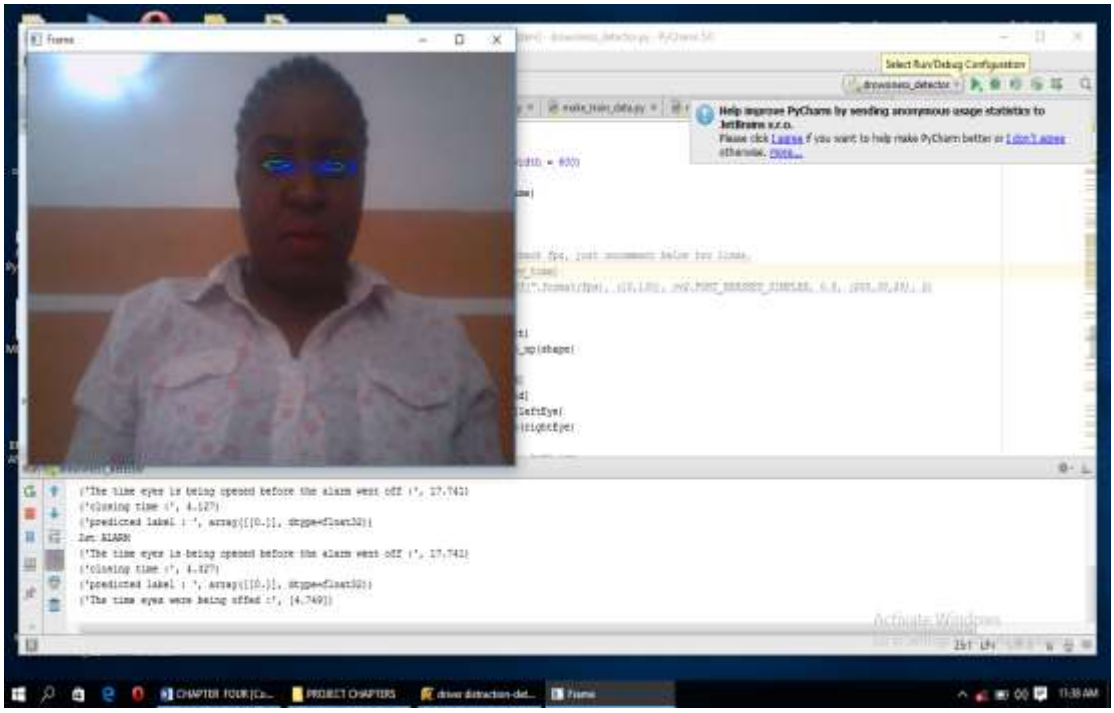

Figure 3: Software output from field.

4.3.1 DESCRIPTION OF THE SYSTEM

The system begins with the initialization phase, which is video acquisition of both face and eyes. Then detection is used to extract both face and eyes regions and takes them as frames to track them in the real time. For each tracking we test if that tracking is good or bad? If the Driver is distracted or not? IF the Eye Aspect Ratio has fallen below the threshold? If the result has fallen below the threshold level then the system sends the signal to the alarm. The alarm buzzes and alerts the driver that he is sleepy and must take a break. If the tracking is good that is the Eye Aspect Ratio is normal then we return to the initialization step and continue to take the next frames from the video. The system will try to track the face again and again if no face is detected. The loud alarm has many positive effects as not only the driver but the passengers seated in the car may also get aware that the driver is distracted and can take the required actions.

5.0 RESULTS AND ANALYSIS

Drowsy/alert detected in 1000 frames capture	Drowsy frames detected	Estimated No of un detected	Alert frames detected	Estimated NO of

		drowsy frames		undetected Alert frame
Alert driver	10	990	23	977
Drowsy driver	34	976	43	956

Table 1: The table above showed the high illumination (strong lightning in direction of the camera) from field.

Frames detected in 1000 frame captured	Drowsy frame	Estimated No of un detected drowsy frames	Alert frames detected	Estimated NO of undetected Alert frame
Alert driver	112	888	840	160
Drowsy driver	658	549	340	654

Table 2: The table above showed the Normal illumination (Normal lightning with good visibility in direction of the camera) from field.

Frames detected in 1000 frames captured	Drowsy frames	Estimated No of un detected drowsy frames	Alert frames detected	Estimated NO of undetected Alert frame
Alert driver	3	997	10	990
Drowsy driver	6	994	4	996

Table 3: The table above showed the Low illumination (Normal lightning with poor visibility in the direction of camera) from field.

5.1 RESULTS AND DISCUSSION

The system performances when evaluations are done under different condition interesting findings were arrived at with different factor identified to be impacting on the performance of the system.

Lighting is a parameter that highly impacts on the performance of the system, when the system is tested on different lighting conditions the results continuously vary depending on the level of external illumination. Under normal lighting condition the performance is high as indicated by the result, under this condition when lighting is controlled the system recorded up to 91% of drowsiness detection however the average drowsiness detection goes down to 65.1% percent. These percentages however vary depending with the prevailing lighting condition.

When illumination increases the performance continuously decreases to a level where there are no detections made. External Illumination affects the brightness of the eye, which in turn leads to changes in the pixel intensity measured. Light from the camera is interfered with by their flections are from the external sources making detection of the target object difficult. This however can be addressed by increasing the light that faces the driver's faces. This helps to fade out the reflections from the other surroundings and to brighten the driver face in order to make it visible from the background through increasing the amount of light the face reflects. However, this approach should be carefully considered so as not to interfere with the drivers eyes, the amount of light emitted in the visible spectrum should be low enough that the driver does not notice or get destructed and ensure that the safety of the eyes is observed.

Reducing the illumination will also diminish the performance of the system, the system makes little detection but as light source becomes darker, the detection levels decrease to zero. This is because the system is depending on the visible light hence not optimized for night vision. To address the night vision the driver cabin can be light using controlled lighting, there the light does not face the camera to prevent interference of the camera light. At night the human surface is associated with low luminance and low reflectance hence the image that will be captured will be of low contrast. To enhance contrast a low source of light can be targeted to the drivers face however just like when the reflectance from the surrounding in high care should be taken on the amount of light to avoid distracting the driver or causing harm to the driver eyes.

The aspect of lack of detection is also manifested with a person with eyeglasses, eye glasses reflects back the light from the camera. This makes it difficult to capture the intensity differences in the eye region. Eye glasses hence affect the performance of system. When the glasses are darker, the impact will be much

higher as some of the light from the camera will be absorbed by the glasses hence the intensity values recorded will be low. The system however does not perform well under occluded eyes; this is because the classifier used in detection of the eye is not optimized for detection of occluded eyes.

The other factor under observation was frame rate, this is important in determining the performance of the system, high frame rates has several advantages, from increasing the levels of accuracy to the amount eye properties to be detected. With very high frame rates, we can be able to determine blink frequency, the blink duration and many other factors. However increasing the frame rates demand for higher memory and processing power, this impacts the performance in embedded environment where these resources are limited. If the frame rate is high and the processing board is very first then the period of detection under study will be very short making the system extremely sensitive. This might lead to constant alerts that might be annoying to the user. This however can be addresses by increasing the number of frames in each loop under observation.

Most embedded systems however have low computational capabilities hence may not be able to handle very high frame rates, in this the number of frames used in drowsiness computation should be reduced to avoid the system taking too long before it arrives at decisions.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 SUMMARY

Today, number of accidents happen during drowsy driving on roads and are increasing day by day. It is a known fact that many accidents occur due to driver's fatigue and sometimes due to inattention factor. This research mainly engages on maximizing the effort in identifying the drowsiness state of driver in real driving conditions. The goal of driver distraction detection systems is an attempt to contribute in reducing these road accidents. The secondary data collected focuses on past research on drowsiness detection systems and various methods have been used earlier for detection of inattention while driving. However, in this project, a real time vision-based method is proposed to monitor driver fatigue. This research approach adopts the Histogram Oriented Gradient to detect the driver's facial features. Firstly, the face is located by a face Landmark Estimation algorithm. The face area is detected using the functions

in the Open CV library with python. Secondly, eye is detected. Also the eye areas are detected by using the functions in the OpenCV library and tracking by using Histogram Oriented Gradient. Then, the open/close state of eyes is determined, and then fatigue is determined based on the series state of eyes. The correlation coefficient template matching method is applied to derive the state of each feature on a frame by frame basis. Vision- based driver fatigue detection method is a natural, non-intrusive and convenient technique to monitor driver's vigilance.

6.2 CONCLUSION

The proposed system in this analysis provides accurate detection of driver fatigue. The analysis and design of driver drowsiness detection system is presented. The proposed system is used to avoid various road accidents caused by drowsy driving and it can also help drivers to stay awake when driving by giving a warning when the driver is sleepy. And also this system used for security purpose of a driver.

During the monitoring, the system is able to decide if the eyes are opened or closed. When the eyes have been closed for too long, a warning signal is issued. Image processing achieves highly accurate and reliable detection of drowsiness. This was achieved by interfacing a webcam to a PC and recording test videos and frame database under different lighting condition. The calculation speed, accuracy and robustness will be influenced by using combined algorithm.

6.3 RECOMMENDATION

To advance this technology further environmental illumination can be addressed through introduction of a module that can estimate the illumination levels and the threshold value for blink detection adjusted accordingly.

In order to advance the performance of the system and incorporate more drowsiness measure parameter, more powerful embedded devices such as FPGA fitted with microcontroller, and more powerful cameras with higher frame rates can be adopted, however the devices in question will be a little more expensive.

To enhance control and more driver situation monitoring a transmission module can be incorporated to transmit the driver state details in real-time to the relevant authorities.

To increase the performance of the system at night or in places with low illumination levels an active method of video capture can be adopted e.g. infra-red camera over the visible light dependent cameras.

In future, the research should be extended to cover more complex user behaviours in front of the camera that indicate drowsiness in drivers, lastly it will be of great benefit to advancement in research in this area if a test databases is developed to help young researchers test their works.

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ISOLATION AND IDENTIFICATION OF PATHOGENIC BACTERIA IN THE SOIL WITHIN A REFUSE DUMPING SITE IN DAMATURU, YOBE STATE

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ABSTRACT
A total of four (4) soil samples were collected from two (2) different dump sites in Damaturu Metropolis, The samples were examined for temperature, pH and total heterotrophic bacterial. The mean temperature values of the soils ranged from 27 to 28°C while the mean pH values ranged from 6.5 to 7.8. The total heterotrophic bacterial population ranged from 142×107, 2.8×108, 2.91×108 and 3.00×107 respectively. The gram reaction and the following biochemical test i.e catalase, coagulase and indole were conducted, the result shows gram positive and gram negative organisms were detected, the biochemical result identified the following organism Bacillus, Escherichia coli, Klebsiella., Proteus, Pseudomonas, Staphylococcus and Streptococcus species. Regular removal of waste from the dump site and adequate sanitary condition around the dump site were recommended.

Keywords:, Bacteria, l Dumping, Pathogenic, Refuse, Soil

INTRODUCTION
Waste (also referred to as rubbish, trash, refuse, garbage, or junk) can be described as unwanted or unusable materials (Wikipedia, 2009). Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded (UNSD, 1997). With population increase, there Is increase in solid waste production making garbage pollution a serious problem (Khupe, 1996). This method of waste management is unscientific; a nuisance to the public, hence, the resultant effect is pollution. The preponderance of open dumps in