UGANDA CHRISTIAN UNIVERSITY

A Centre of Excellence in the Heart of Africa

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Course	:	BACHOLERS OF SCIENCE IN COMPUTER SCIENCE
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THE INFLUENCE OF ROAD TRAFFIC MONITORING SYSTEM TO THE TRAFFIC USERS IN KAMPALA CITY BY KNOWLEDGE-DRIVEN STATIC AND DYNAMIC IMAGE ANALYSIS

Keywords: Motion segmentation; Image analysis; Motion estimation; Road-traffic monitoring; Vehicle classification; Vehicle tracking

1. Introduction:

Since the automobile became a popular phenomenon, the need to watch over the safety of motor vehicle occupants and the rest of the people included in road safety emerged. The proliferation of these moving elements forced governments to take measures to guarantee good driving habits as well as safe driving on the roads where these vehicles traveled. Although the first highway code had already been put into effect, it was obvious that it was not enough to guarantee that the above-mentioned requirements (good driving habits and safe driving) would be fully complied with. Other mechanisms had to be put into effect to make traveling as safe as possible at all times. the use of automatic mechanisms capable of providing information about the behavior of automobiles on highways and a cross Kampala city

character of the system to be developed;

A vehicle which inherits the characteristics of the object is created and the object is eliminated.

The vehicle is classified, according to its type.

The type of vehicles established as valid vehicles are

- Motorcycle,
- Car,
- Van,
- Heavy Vehicle (both trucks and buses are included).

If the object does not belong to any type, it is labeled as a ‘‘Foreign object’’.

(b) risks and uncertainties of the project;

Dynamic surveillance

Using the previous information, the ‘‘Dynamic Surveillance’’ task can start doing his/her job of detecting irregularities linked to object motion. When an incident is detected, the controller is informed. Moreover, information ‘‘Dynamic alarms’’ is created, which contains all the incidents detected in the task ‘‘Dynamic Surveillance’’ in this execution cycle.

That information contains the following:

Dynamic incidents

- Date and time of the incident.
- Type of incident.
- Type of vehicle involved, as well as the assigned tag.
- Place on the road where the incident has taken place.

First, the value of the speed of each current vehicle is extracted. If that speed is less than the minimum corresponding speed, an indication that there has been an incident involving lack of speed is stored in a data structure. If the speed is greater than the maximum corresponding limit, information about an incident involving excessive speed is stored. Later, all the final matches are checked over, and:

- The coordinates from the center of the previous and current vehicle implicated in the match are recorded. The longitudinal distance and the transverse length traveled by the vehicle are calculated. If the vehicle’s movement is mainly transverse in the scene, an incident involving a strange movement is indicated.

- The segment from the intermediate line which separates the coordinates from both centers is checked over. If three consecutive black pixels are found, an incident of solid line overstepping is reported.

All previous unmatched vehicles are gone through. If any of them is stopped, an incident involving a stopped vehicle is reported. This means that the counter for the number of stopped vehicles increases by one and if that counter is equal to or greater than the threshold established, information about an incident involving a traffic jam is stored.

(c) user requirements concerning implementation.

Functional Requirements technical plan:

Functionalities of the traffic monitoring tasks

Task Module's function:

Static analysis:

- It is in charge of the sequence path of the current segmented image, eliminating noise from it
- and extracting information from moving objects.
- It later examines which of these objects belong to valid types of vehicles.
- It calculates the dimensions and position of each vehicle.
- It controls the incidents which can be determined by studying the current image.

Dynamic analysis:

- It is in charge of comparing the information gathered from the vehicles in the segmented image from the previous cycle with the information gathered from the static analysis of the current cycle.
- It is in charge of matching previous and current vehicles.
- It calculates each vehicle's speed.
- It determines whether a vehicle has gone in or out of the area of analysis.
- It controls incidents that occur as a consequence of the vehicles' motion

Results generator:

- It gathers all the information provided by the other two tasks and gives them the proper format to be stored in the Results data base

2. Recommended approach:

The recommended approach we need to watch over the safety of motor vehicle occupants and the rest of the people included in road safety emerged. The proliferation of these moving elements forced governments to take measures to guarantee good driving habits as well as safe driving on the roads where these vehicles traveled. Although the first highway code had already been put into effect, it was obvious that it was not enough to guarantee that the above-mentioned requirements (good driving habits and safe driving) would be fully complied with. Other mechanisms had to be put into effect to make traveling as safe as possible at all times.

Road-traffic monitoring approaches:

A great number of road-traffic monitoring systems are based on motion detection to segment the regions of the image.

Motion detection by frame differentiation is also the nucleus of a system capable of counting vehicles, measuring their speed and tracking them in complex highway crossings

DEVELOPMENT APPROACH

Rapid Application Development (RAD).

In the RAD approach, we shall

- break overall system into a series of versions
- Each version has Analysis, Design, and Implementation
- Have Output from one version to be the input to the next
- Incorporate ideas, issues, lessons learned in one version into the next version

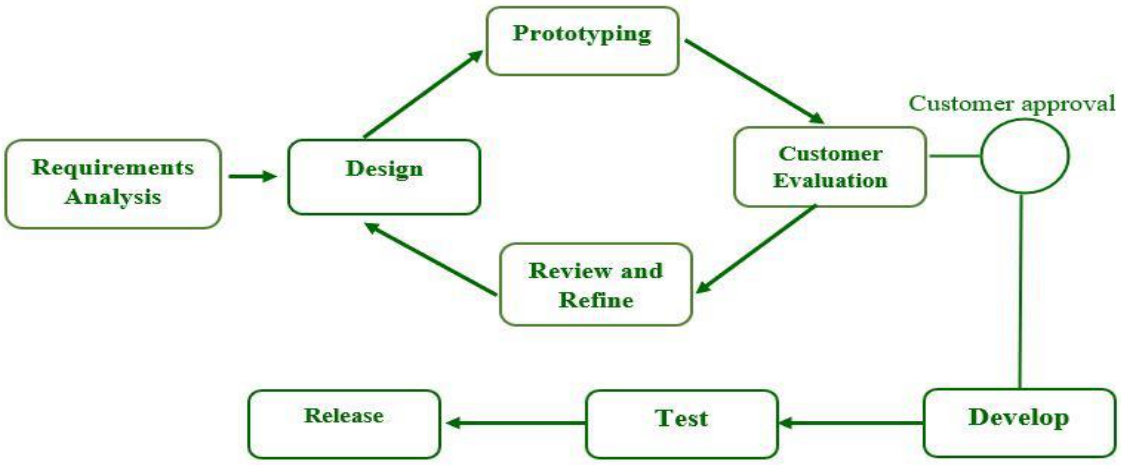
With this approach, the main functions of the system are tested first while the user gets a system to be using as its still in development.

Prototyping under RAD approach.

we will use system prototyping for our system

- Analysis, Design, Implementation are performed concurrently
- Start with a "quick-and-dirty" prototype
- Provides minimal functionality
- Repeat the process, refining the prototype each time
- Stop when the prototype is a working system

The diagram below explains how our prototyping approach will be implemented.



[1]

Figure 1 prototyping structure -- https://www.geeksforgeeks.org/software-prototyping-model-and-phases/

SELECTED METHODOLOGY OR PROCESS MODEL;

REQUIRED SOFTWARE TOOLS, DESIGN AND DEVELOPMENT TOOLS

These are sets of technological equipment used to develop a system. This section covers the different tools, both software, and hardware that are required to develop the visually impaired system using voice and image processing technologies.

Design Tools

1. Use Case Diagrams
2. Flow charts Diagrams

Sketch d**DEVELOPMENT APPROACH**

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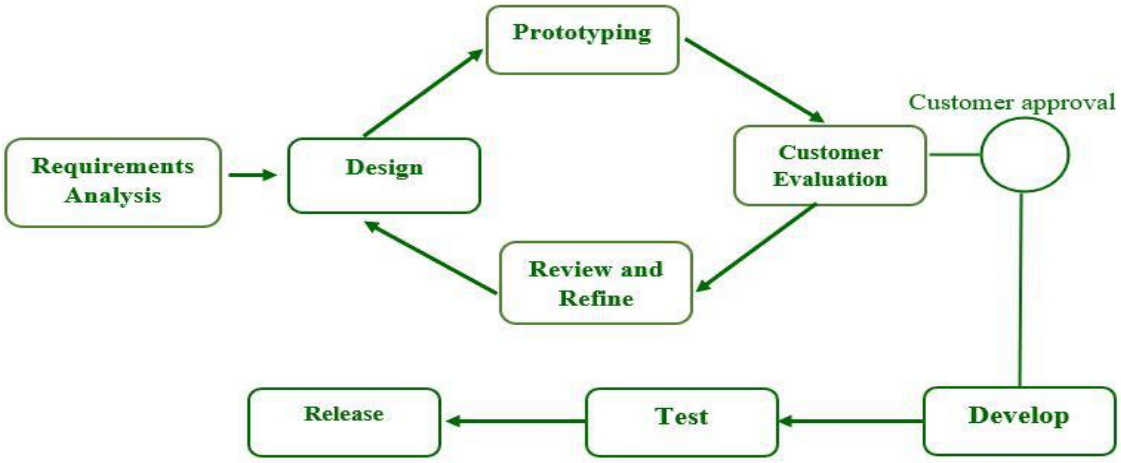

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PROGRAMMING LANGUAGES TO BE USED.

1. **Frontend and backend**
    a. flutter dart framework
    b. Django with python for ML and AI (for web based)
2. **Database**
    a. Firebase and MySQL
3. **Other technologies**
    a. **Deep learning**
    b. **Machine learning**
    c. **Algorithms**
    d. **Cloud services**

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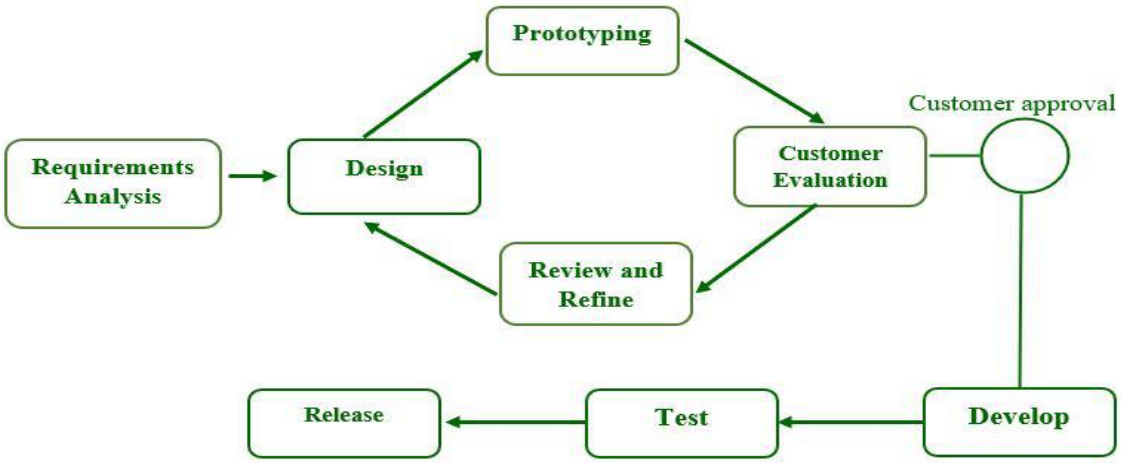

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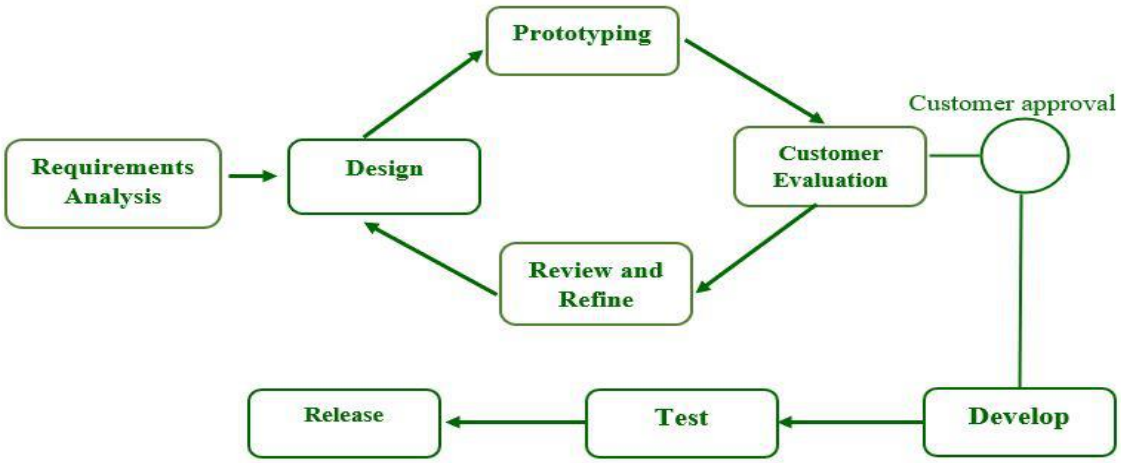

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9. Use Case Diagrams
10. Flow charts Diagrams
11. UML diagrams

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And why?

The Waterfall technique is a well-defined, uncomplicated project management methodology with a track record. Because the requirements are written out from the start, each contributor knows exactly what needs to be done when and can plan their time effectively for the course of the project.

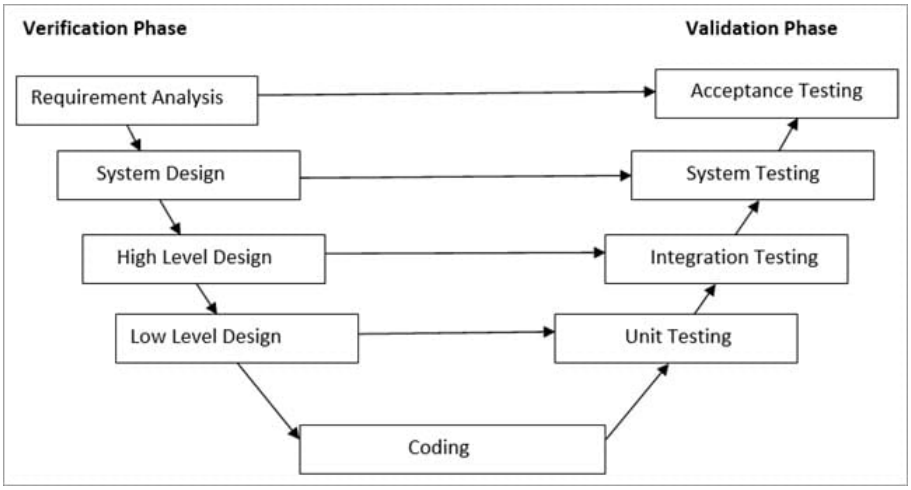
For smaller projects with well-defined and well-understood needs, the waterfall model works well.

(a) development methods;

V-Shaped Model

V- Model is also known as Verification and Validation Model. In this model Verification & Validation goes hand in hand i.e. development and testing goes parallel. V model and waterfall model are the same except that the test planning and testing start at an early stage in V-Model.

V-Shaped Model



a) Verification Phase:

(i) Requirement Analysis:

In this phase, all the required information is gathered & analyzed. Verification activities include reviewing the requirements.

(ii) System Design:

Once the requirement is clear, a system is designed i.e. architecture, components of the product are created and documented in a design document.

(iii) High-Level Design:

High-level design defines the architecture/design of modules. It defines the functionality between the two modules.

(iv) Low-Level Design:

Low-level Design defines the architecture/design of individual components.

(v) Coding:

Code development is done in this phase.

b) Validation Phase:

(i) Unit Testing:

(ii) Unit testing is performed using the unit test cases that are designed and is done in the Low-level design phase. Unit testing is performed by the developer itself. It is performed on individual components which lead to early defect detection.

(ii) Integration Testing:

Integration testing is performed using integration test cases in High-level Design phase. Integration testing is the testing that is done on integrated modules. It is performed by testers.

(iii) System Testing:

System testing is performed in the System Design phase. In this phase, the complete system is tested i.e. the entire system functionality is tested.

(iv) Acceptance Testing:

Acceptance testing is associated with the Requirement Analysis phase and is done in the customer’s environment.

(c) required software tools;

No	Type of hardware	Use	Quantity
1	Laptop computer	To research, design, develop and document the system.	1
2	1TB hard disk	To transfer files	2
3	Printer	To print documents	1
4	2TB hard disk	For offline backup of the system	1
5	Smart phone	For research and testing the system	2
	camera	CCD camera is mounted looking vertically down on a roadway, giving a _eld of view of about twenty-_ve metres	5
6	Modem / router	Alternative for internet connection	1

SOFTWARE TOOLS

No	Software's	Use	Description

1	MS office word	Documentation	MS office 2016 is used for writing documentation starting from proposal up to the end.
2	Draw.io	Documentation	Visual paradigm was used to draw the diagrams (context diagram, flow chart, Data flow diagram, entity relationship diagram)
3	Android studio	Development and testing	A compiler development and testing of the application
4	Visual Studio Code	Development	For actual development of the frontend of the web Application version
5	Git Bash	Version Control	This application is used for pushing, pulling and all the other git operations
6	Java Eclipse	Development and testing	This application is an integrated Development Environment.
7	Postman	For testing of REST Applications	This is an application used to make requests to the server and testing the responses.
8	Viso.ai	Referencing the algorithms	Area for referencing algorithms and API integrations

(d) target hardware/software environment

A CCD camera is mounted looking vertically

down on a roadway, giving a _eld of view of about twenty-_ve metres. The full image is

digitized and stored but processing is carried out on only about twenty pixels per traffic

lane. Vehicles are detected by a frame di_erencing technique using a threshold to cope with

variations in lighting, shadows and noise. The system is able to work in both day and night.

Worst case results from testing indicate that vehicle count can be measured with an error

of 4%, vehicle speed (less than 75mph) with an error of 8%, vehicle speed (over 75 mph)

with an error of 16%, vehicle length (under 75 mph) with an error of 8% and vehicle length

(over 75 mph) with an error of 16%.

IMPACTs

It operates at a macroscopic level in that it does not attempt to identify or

track individual vehicles but it provides a qualitative description of the spatial distribution

of moving and stationary traffic in a scene. The system splits the image up into a number of

cells, each cell being approximately the width of a lane and the length of a car (so cells over

more distant parts of the road are smaller because of perspective). Each cell can be in one

of three states; no vehicle, stationary vehicle or moving vehicle. Cells which have a common

state is grouped together along the length of a traffic lane into objects. Objects involving

stationary traffic represents queues. The state of a cell is determined using two algorithms,

one to detect vehicles and one to detect movement. Vehicles are detected by looking

3. Implementation:

Traveling too slowly or too fast:

- If the speed of the current vehicle exceeds the minimum between the highest speed limit for that type of vehicle and the highest limit for the lane where the vehicle is currently traveling in, an incident involving excessive speed is detected, that is, if the speed is below the maximum between the lowest speed limit for that type of vehicle and the lowest limit for the lane the vehicle

is currently traveling in, an incident involving a vehicle traveling too slowly is detected

Overstepping a solid line:

- The reference image is checked to see that there is no solid line established between the position of the previous and current vehicles.
- To do this, we go through the middle row between the centers of both vehicles and from the column of one of them to that of the other.
- We also check to see if there are three consecutive black pixels

Stopped vehicle:

- A previous vehicle that is not matched to a current one, that is, a vehicle that has disappeared from the scene and whose speed had slowed down or had traveled at a lower speed that the minimum speed limit

Traffic congestion:

- When the number of stopped vehicles is greater that the threshold set up, it is considered a traffic jam

Strange movement:

- An object moves in such a way that its transverse movement is greater than its longitudinal one. The longitudinal movement is the number of rows of pixels which separates the previous from the current vehicle. The transverse movement is the number of columns which separates the two

(a) required development environment:

(b) required maintenance environment;

(c) required training.

4. Implications:

Conclusion:

The knowledge-driven system capable of controlling traffic on highways and freeways in one direction of traffic. At maximum, the application controls three lanes of regular traffic (right, middle and left) and an entrance/exit ramp. The images are captured by a video camera mounted on top of a bridge, digitized and transferred to a moving objects recognition system. Through segmentation, this system provides a sequence of images where the movements of the objects in the scene are shown. The application developed eliminates noise in the segmented images and it detects moving objects through a sequential run of the pixels in those images.