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Road sign identification application using image processing and augmented reality

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Abstract: Now days, Sri Lanka is a rapidly developing country in the world. With this regard, roads are developing in every area. Every year, many new vehicles are entering to the roads. People use roads for their transport requirements. The road signs boards are helped to control road traffic and accident. But today, road accidents are increasing rapidly. Most people are getting injured. Some people lost their life due to accidents. So many properties are damaged. Therefore, lives, properties, time and money are lost. A main reason of road accidents is a lack of knowledge about road signs and rules. To overcome this problem, "the developed team" has developed a learning Android Mobile Application. It is named "Mansalakuna". This Mobile Application can be identified road signs using mobile phone camera. The road signs which focused by mobile phone camera, can be identified using the Image Processing Technology. Then, the mobile application is delivered full information about the road signs on user's mobile phone screen for use the Augmented Reality Technology. The results can be delivered instantly to the user with specific rules, laws and regulations related for that road sign. Otherwise "Mansalakuna" mobile application can be used for learning mobile applications for passengers and drivers on the way. Countries like Sri Lanka, there are no complete above mention mobile applications package for the road users. Therefore, this Android Mobile Application is given a considerable support to users. It is a start to digital era to the road users.

Key words – Road Signs, Image Processing, Android Mobile Application, Augmented Reality, Mobile phone camera.

I. INTRODUCTION

Now days, the population is growing rapidly. Therefore, the needs of the peoples as well as the number of people using the transport methods are increased. Many numbers of vehicles are entered to the road day by day. Therefore the road system is developed in heavily. Many rural roads are getting develop and new highways are joined the national road system. As a result, road accidents are increased daily. Most people are getting injured and some people are died untimely. Also, lots of properties and money are lost due this. Annually, More than 2000 people were died in accident during last few years. Today, this is a national problem in the country. Mostly the drivers and the passengers should be responsible for that. There are many reasons for the road accidents. The lack of knowledge about road signs is a one of the main reason for this problem. To reduce this problem, our team supposed to develop learning Android Mobile Application. Currently, there are no any kind of a Mobile Application to identify a road sign, learn what it is and inform the road rules and regulations.

Road signs are the signs erected at the side of or above roads to give instructions or provide information to road users. It is made to reduce accidents from the roads. "Mansalakuna" mobile application can identify the road signs using mobile device camera. Road signs are detected using digital image processing technology. Then the application delivers the information about that road sign and specific road rules, laws and regulations related to that specific road sign. It is displayed by augmented reality technology. There are several kind of road sign detection systems to identify road signs and give the messages for drivers while driving. But this application is given the results instantly using augmented reality.

II. LITERATURE REVIEW

This section discusses the previous research conducted on road sign detection. To detect road signs using augmented reality and image processing is a newly developed task for the research team and the researchers gathered and collected data through several kind of background studies and case studies. There are several kinds of applications, web applications and manual engines to identify road signs in some smart vehicles and kind of automotive engines. Currently there are no android based application that could

deliver information about a road sign using augmented reality.

Piccioli, Micheli and Parodi propose a Robust method for road sign detection and recognition system [2] to identify and detect the road signs. This paper describes a method for detecting and recognizing road signs in grey-level and color images acquired by a single camera mounted on a moving vehicle. The method works in three stages. First, the search for the road sign is reduced to a suitable region of the image by using some *a priori* knowledge on the scene or color clues (when available). Secondly, a geometrical analysis of the edges extracted from the image is carried out, which generates candidates to be circular and triangular signs. Thirdly, a recognition stage tests by cross-correlation techniques each candidate which, if validated, is classified according to the database of signs. An extensive experimentation has shown that the method is robust against low-level noise corrupting edge detection and contour following, and works for images of cluttered urban streets as well as country roads and highways. A further improvement on the detection and recognition scheme has been obtained by means of temporal integration based on Kalman filtering methods of the extracted information. The proposed approach can be very helpful for the development of a system for driving assistance.

Gavarila and Philomin studied about Real time object detection for smart vehicles [7] and they proposed a system for smart vehicle types. This paper presents an efficient shape-based object detection method based on Distance Transforms and describes its use for real-time vision on-board vehicles. The method uses a template hierarchy to capture the variety of object shapes; efficient hierarchies can be generated offline for given shape distributions using stochastic optimization techniques (i.e. simulated annealing). Online, matching involves a simultaneous coarse-to-fine approach over the shape hierarchy and over the transformation parameters. Very large speed-up factors are typically obtained when comparing this approach with the equivalent brute-force formulation; we have measured gains of several orders of magnitudes. We present experimental results on the real-time detection of traffic signs and pedestrians from a moving vehicle. Because of the highly time sensitive nature of these vision tasks, we also discuss some hardware-specific implementations of the proposed method as far as SIMD parallelism is concerned.

Hidehiko and Imai describe and identified about image processing and it's visualization effects by their research and this methods are very useful to apply the project "Man Salakuna" road sign application. Road Signposts Recognition System [10] describes the image visualization and during motor vehicle operation, the image processing and pattern recognition of various external visual information to assist human vision is an effective method to improve safety and driving comfort. Research into image processing and pattern recognition, supported by advancing device and computer technology, is entering the age of practical application. Against this background, developed a system to visually detect, recognize and transmit to the vehicle operator road signs, which are definable patterns, as the first step in the application of image processing and pattern recognition technology to the automotive sector.

Tsai and Hsieh and the team recognized road sign detection using Eigen color. [8] The Researchers studied from this novel color-based method to detect road signs directly from videos is presented. A road sign is usually painted with different colors to show its functionalities. To detect it, different detectors should be designed to deal with its color changes. A statistic linear model of color change space that makes road sign colors be more compact and thus sufficiently concentrated on a smaller area is presented. On this model, only one detector is needed to detect different road signs even though their colors are different. The model is global and can be used to detect any new road signs. The color model is invariant to different perspective effects and occlusions. After that, a radial basis function (RBF) network is then used to train a classifier to find all possible road sign candidates from road scenes. Furthermore, a verification process is applied to verify each candidate using its contour feature. After verification, a rectification process is used for rectifying each skewed road sign so that its embedded texts can be well segmented and recognized. Due to the filtering effect of the proposed colour model, different road signs can be very efficiently and effectively detected from videos.

Miura, Kanda and Shirai An active vision system for real-time traffic sign recognition system. This paper presents an active vision system for real-time traffic sign recognition. [6] The system is composed of two cameras; one is equipped with a wide-angle lens and the other with a telephoto-lens, and a PC with an image processing board. The system first detects candidates for traffic signs in the wide-angle image using color; intensity, and shape information. For each candidate, the telephoto-camera is directed to its predicted position to capture the candidate in a larger size in the image. The recognition algorithm is designed by intensively using built-in-functions of an off-the-shelf image processing board to realize both easy implementation and fast recognition. The results of on-road real-time experiments show the feasibility of the system.

Huang and Hsu describes about Road sign detection and recognition using matching pursuit method. [4]This paper describes an automatic road sign recognition system by using matching pursuit (MP) filters. The system consists of two phases. In the detection phase, it finds the relative position of road sign in the original distant image by using a priori knowledge, shape and color information and captures a closer view image. Then it extracts the road sign image from the closer view image by using conventional template-matching. The recognition phase consists of two processes: training and testing. The training process finds a set of best MP filter bases for each road sign. The testing process projects the input unknown road sign to different set of MP filter bases (corresponding to different road signs) to find the best match

Neumann and Azuma introduced Hybrid Inertial and Vision Tracking for Augmented Reality Registration.[13]This

system was built to develop stable, accurate and robust tracking methods for wide-area Augmented Realities, especially in unprepared indoor or outdoor environments. To achieve this, the developers has explores a range of related issues, including robust natural feature detection and tracking methods, extendible vision tracking with natural features and new-point estimation techniques, and Kalman filters for pose estimation. This work combines their methods for fiducially and natural feature tracking with inertial gyroscope sensors to produce a hybrid tracking system. The two basic tenets of this work are:

- Inertial gyro data can increase the robustness and computing efficiency of a vision system by providing a frame to frame prediction of camera orientation.
- A vision system can correct for the accumulated drift of an inertial system.

In this system they use motion tracking, cameras, and sensors to track the indoor and outdoor environment objects. Basically the theories of tracking using augmented reality helpful to develop “Man Salakuna” and its technologies.

Gomboss and Matuzka introduced a System named Indoor Navigation Using Semantic Web technologies and Augmented Reality. They have founded some kind of new approaches to develop their System. In year 2012 project investigate the possibilities of the indoor navigation systems. On the basis of developers wanted plan and implement an application on Android mobile. Using AR and map for the visualization of the navigation. Use the advantage of the Semantic Web and the AR. [17] Using this system, users can navigate through an environment which has a map and that contains QR codes and AR markers. The application provides two types of navigation visualizations. Both visualizations are based on the user’s interactions. The first is the pedometer, which uses the data provided by the accelerometer and by the compass. This tool shows the way that leads to our destination and the traveled distance on a map. The second visualization based on augmented reality, which extends the image of mobile’s camera with virtual objects.

Mobile devices are getting popular as a platform for Augmented Reality (AR) application such as a Smartphone. Mobile AR is mainly available whenever people require an informational support for a focused task. Although the mobile AR application is getting popular, only a limited number of researches are available. This paper in turn presents an overview of potential or current uses of mobile AR application from the first development of mobile AR application in 1997 until now. The objective is to observe the trend and the importance of mobile augmented reality by focusing on sports, games and entertainment, cultural heritage, medical, education and training and marketing/advertising area depended on where it can be applied. Our results then indicate that mobile AR is a potential tool to assist a user in many tasks. [18]

Recent advances in hardware and software for mobile computing have enabled a new breed of mobile AR systems and applications. A new breed of computing called “augmented ubiquitous computing” has resulted from the convergence of wearable computing, wireless networking and mobile AR interfaces. In this paper we provide a survey of different mobile and wireless technologies and how they have impact AR. Our goal is to place them into different categories so that it becomes easier to understand the state of art and to help identify new directions of research. [17] [18]

Those are some kind of surveys and wireless technology systems for augmented reality technologies. To implement a new system to recognize road signs those kind of AR related surveys more helpful for the research team.

III. METHODOLOGY

This section discusses the methodology was used to implement the system. Prototype methodology was used to implement this Android based application. Prototype method, allowed the team to get some insights to refine the actual requirements of the system.

Figure 6 depicts the high level architecture diagram of the application. An android smart phone user could use this system. The interfaces were developed using Android Eclipse software.

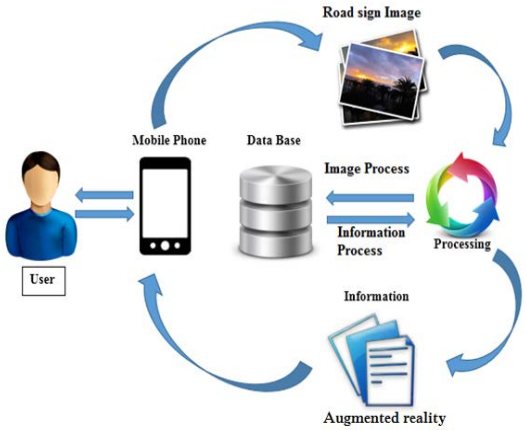

Figure 1: High-level Architecture Diagram

First, the mobile phone is focused to the road sign board. In available, the focused road sign is matched between the stored road sign image from mobile phone. In there, “OpenCV” library is using for this. If the focused road sign and stored image are matched, Then This road sign details will be displayed on mobile phone screen from database in instantly. In there, “Wikitude” library is using for display the stored road sign image and the road sign details for this. Otherwise “Mansalakuna” Android mobile application is showed about road sign details, rules and regulations.

Mobile application was implemented using Android Eclipse. In there, Java programming language was used to code the functions. Database was created using “MySQL”.

The mobile application connects with the database through the cloud computing technology.

"OpenCV" (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real time image processing was used for image processing. "Wikitude" is a library of programming functions mainly aimed at Augmented Reality. It was used to implement augmented reality.

A. Image processing code

//Please make attention about BGRA byte order

```
JNIEXPORT void JNICALL
Java_org_projectproto_objtrack_ObjTrackView_CircleObje
ctTrack (JNIEnv* env, jobjectthiz, jint width, jint height,
jbyteArrayyuv, jintArraybgra, jboolean debug){
jbyte* _yuv = env>GetByteArrayElements(y,v,0);
jint*_bgra=en>GetIntArrayElements(bga, 0);
Mat mYuv(height + height/2, width, CV_8UC1, (unsigned
char *)_yuv);
Mat mBgra(height, width, CV_8UC4, (unsigned char
*)_bgra);      Mat mGray(height, width, CV_8UC1,
(unsigned char*)_yuv);   CvSize size = cvSize(width,
height);                                    IplImage
*hsv_frame = cvCreateImage(size, IPL_DEPTH_8U, 3);
IplImage *thresholded
=cvCreateImage(size,IPL_DEPTH_8U, 1);
IplImageimg_color = mBgra;
IplImageimg_gray = mGray;
```

Text 1

```
spacecvCvtColor(&img_color, hsv_frame,
CV_BGR2HSV);
```

Text 2

// Filter out colors which are out of range.

```
(ping-pong ball hue ~ 14) cvInRangeS(hsv_frame,
cvScalar(9, 70, 80, 0), cvScalar(19, 250, 250, 0),
thresholded);
```

Text 3

// Find circle patterns

```
CvSeq* circles = cvHoughCircles(thresholded, storage,
CV_HOUGH_GRADIENT,1.5,thresholded->height/4,
100, 40, 15, 80);
```

Text 4

// draw found circles

```
for (inti = 0; i<circles->total;i++)
for (inti = 0; i<circles->total &&i<3; i++) // max 3
circles
{
        float* p = (float*)cvGetSeqElem( circles, i
        );
        circle(mBgra, Point(p[0],p[1]), 3,
        Scalar(0,255,0,255), 2);
        circle(mBgra, Point(p[0],p[1]), p[2],
        Scalar(0,0,255,255), 4);
```

Text 5

//Create tracker

```
Var World={loaded:false,init: function initFn(){
this.createOverlays();},
createOverlays: function createOverlaysFn() {
this.tracker = new
AR.ClientTracker("assets/magazine.wtc",{ onLoaded:
this.worldLoaded
});
```

Text 6

// Create overlay for page (example)

```
var imgOne = new
AR.ImageResource("assets/imageOne.png");
var overlayOne = new
AR.ImageDrawable(imgOne, 1,{
        offsetX: -0.15,offsetY: 0
                        });
var pageOne = new
AR.Trackable2DObject(this.tracker, "train",{
drawables:{
                cam: overlayOne
                        }
                });
```

Text 7

//Display details on the screen

```
worldLoaded: function worldLoadedFn() {
var cssDivInstructions = " style='display: table-cell;vertical-
align: middle; text-align: right; width:      50%; padding-
right: 15px;'";
var cssDivSurfer = " style='display: table-cell;vertical-align:
middle; text-align: left; padding-right: 15px; width: 38px'";
var cssDivBiker = " style='display: table-cell;vertical-align:
middle; text-align: left; padding-right: 15px;'";
document.getElementById('loadingMessage').innerHTML
=
"<div" + cssDivInstructions + ">Scan Target &#35;1
(surfer)
or&#35;2(biker):</div>"+"<div"+cssDivSurfer+"><img.src
='assets/surfer.png'></img></di"+"<div" + cssDivBiker +
"><img src='assets/bike.png'></img></div>";
```

Text 8

IV. RESULT & DISCUSSION

The mobile phone camera is focused the road sign. The application is displayed the identified road sign details on mobile screen when mobile camera is focused to road sign. The focus road sign and stored road sign image are compared by "OpenCV" library in Image Processing. In compared, Color is compared by RGB color system It is converted HSV color system for identify circle pattern. In there under road sign is displayed the rules and regulations

using Augmented Reality. In there, the stored road sign image rule and regulations is shown on the mobile screen using "Wikitude" library. The research team tested "Mansalakuna" mobile app for accuracy and reliability. Figure 2 and 3 depicts screen shots taken from the mobile application.

Figure 2: Identifying a 'Left Turn' road sign using augmented reality

Figure 3: Identifying a 'No Entry' road sign using augmented reality

The reliability of the system might not be 100% at all times due to the image quality.

This tool handles ten different road signs stored in the database.

In the testing process for the road sign recognition and road sign detection, in some cases the team did not get the actual output as team expected. In some cases the system was unable to detect the road sign which are in front of its camera. The development team tested the system in different aspects to detect this fault. This was mainly due to the poor lighting conditions, higher lighting conditions and the dark backgrounds. Therefore in order to get the accurate output, it is required to have moderate lightning conditions with an appropriate background. Development team would update database according to the new arrivals.

This research development team limited scope to Basic Road Signs. Bad weather conditions and maximum three road signs can detect at once are the other limitations. The research team is able to expand this application for all kinds of road signs in the future. And also the research team will able to minimize the weather condition faults. Also the research team will able to use this application at night and the team will able develop those camera and sensitivity of the "Mansalakuna" Android Mobile Application in near future.

V. CONCLUTION

Today, most of the people do not care road signs when they drive or walk sideways on the road and some people do not know even the name of the road sign that they see. Here developing "Mansalakuna" Android Mobile Application: Building a tool based on Image Processing and Augmented Reality. Research team is provided accurate tool for display road signs and road rules details lively.

Augmented Reality is played major role in modern technology. Many researchers research to using AR concept for new innovation. But in Sri Lanka there are not any accurate Mobile Application Tool like "Mansalakuna". Main objective of this research is to displayed accurate details for user lively. Once the user selected the road sign, the image would be processed and display in details within 1-2 seconds. Here using this precious tool, consumer can see the road signs in details, like name, rule and regulations in lively.

When consider about quality of this system, tool is one of the high quality product. User does not worry about trustworthy of this tool because all the details about the road signs are inserted by administrator. Development team acts as administrator. Another person cannot hack details, because Administrator has use name and password, to prevent access from unauthorized persons misusing the system. Trustworthiness of this "Mansalakuna" Android Mobile Application tool is 100%. Sometime you will think how details are updated according to new arrivals. No reason to worry about that, because research team is responsible for this product and all the maintenance and modifications. Alterations are done by research team as soon as possible. When, a new road sign is recognized that details are added into the database in immediately. Most of the applications are not available when user wants it. But this tool is not like that as it is available at any time. Using this "Mansalakuna" Android Mobile Application tool definitely user can select road sign quickly and enjoy safe journey.

If user likes to use this mobile application to understand the road signs, he should consider about limitations. This tool displays "road sign details" using real time image processing and research team used color and shape tracking methods for real time image processing. Because of that detected image output will be depended with light of environment. Due to that reason user should careful about changes in the environment.

This Android Mobile Application is connected with database using web service. Therefore fast internet connection is very essential and failure of the internet connection will affect performance of the tool. If user wants to get best performance from this tool, should have a fast internet connection. When compare with other augmented reality applications this limitation won't be major issue and customer does not want to worry so much about these limitations.

For develop real time image processing component research team used "OpenCV" library file with android platform. Therefore research team could not develop an algorithm to

separately identify one particular road sign from a lot. But that is not a major issue. This "Man Salakuna" Mobile Android Application accuracy is low, that issue comes with "OpenCV" library. Because development team tracked road sign using color and shape. In the world, road sign have many colors and shapes.

In the future this "Mansalakuna" Android Mobile Application tool can be developed further in many ways. Within our research scope development team limit only several types of road signs. Therefore researches who likes to implement another system based on our research they can develop this. Here development team failure to detect road sign using Android Technology, in future other researches can implement this tool using Android. Researches can implement this research to separate a particular road sign from lot. As a research team we also wish to implement this research further for all road signs. This Android Mobile Application tool will be developed to IOS and this may further for users to define the road signs for the successful their safe journey. A key measure of Augmented Reality systems is how realistically they integrate augmentations with the real world. Modern mobile augmented reality systems are used one or more of the following tracking technologies: digital cameras and/or other optical sensors, accelerometers, GPS, gyroscopes, solid state compasses, RFID and wireless sensors. These technologies are offered varying levels of accuracy and precision. Most important is the position and orientation of the user's head. Tracking the user's hand(s) or a handheld input device can provide a 6DOF interaction technique. Finally the team hopes that the research would be of benefit on a global level. The team hopes that this study will be helpful for the researchers who are interested in Augmented Reality and image processing to design and develop similar models or to develop the same device further and use this concept with their projects.

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