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DATA VISUALIZATION USING MARKER-BASED AUGMENTED REALITY TECHNIQUES

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Abstract

Augmented reality is one of the fastest growing technologies in the world today. It has been incorporated in a number of successful applications and is one of the most useful and effective high-end tools for industries like E-learning, E-commerce. Although Augmented Reality is supported by most android phones these days, further improvements in features are required. The research focuses around data visualizations displayed through augmented reality. This approach helped organizations to categorize and organize data in a manner that improved market analysis and economic growth. Capitalizing on this technology further, it would be immensely helpful to educate users about different food items and their nutritional contents. The use of information graphics displayed through Augmented Reality technique would be able to provide a more comprehensive view about the food item under consideration and help users make better lifestyle choices. The visualizations of classification have been obtained in the form of confusion matrix and forwarded to the Unity engine for embedding it with the Augmented Reality application for augmenting the visualizations and displaying 3D views to the end users.

Keywords: Data analysis, Visualization, Augmented reality, Multiclass Classification, OneR classifier

1. Introduction

One of the primary objectives of Data Visualization is to give a clear and quick view of the examination acquired from the datasets. One can undoubtedly separate bits of knowledge to go with quick information-driven choices for the organization's advantage. Most decision-makers do not have a lot of time and would rather look at visual representations of data [B. Marques et al (2019)]. Augmented Reality is where images, such as graphics, alphanumeric, photographs, videos, etc., are superimposed on to the real world. Reality is what we see normally most of the time without any special viewing devices, and it is normally in stereoscopic 3D. If we can see only the artificial added images, as a simulation of reality (a “virtual world”) but not the real world (such as with opaque headsets), that is virtual reality (VR). If we wear AR goggles or AR glasses that are transparent so that we can see the real world through them, but allow additional images to be superimposed which may also be in stereoscopic 3D, that is augmented reality. The application scans the picture received from the phone camera, then the picture is processed by the HOG algorithm, and similar points to the pictures from the camera and the marker images are found. After the successful finding, the application analyzes the rotation and position of the picture and adjusts the animation directly for these points.

2. Literature Survey

Through field research, educators experience new technology of using HoloLens for interactive study purposes. [1]. This technology uses Hololenses, to help to study movements of various body parts used by medical students for study purpose and for correct treatment. [2][3]. S. Howard, et al., fostered an application for including computer generated reality content for most recent training. which worked with a special chance to cooperate to lay out an exploration project creating and upgrading the

abilities and attention to college staff and understudies inside the area of Virtual Reality. [4] A review performed by Willicks, Freya, et al., to overview about the understudies' view of Mixed Reality in instruction. It showed that more youthful understudies have more grounded ability. They arranged questions like what does understudies partner with the term Mixed Reality [6]. Forebearing Onie, James Hamish, Roger Austin, Victor McNair, in 2017 introduced their investigation of perception involving Augmented Reality and Virtual Reality for cutting edge designing instruction purposes [7]. Crafted by Vinh T. Nguyen and Tommy darn pointed towards building a computational reasoning game application having a far reaching system assembled utilizing VR and AR; every part of the application was coordinated utilizing Unity game motor and they likewise tended to normal difficulties they looked while building the application.[8]. Agate Lis-Marciniak, et al., examined how the testing stage is significant before definite conveyance of the Mixed reality stage . [9] Milena Duntsch, et al., concentrated on the utilizations of MR brilliant glasses for intuitive working where the utilization of HMD of Microsoft HoloLens to imagine objects in 3D arrangement [10]. Oleksy, T., et al., talked about the utilization of Augmented Reality for game advancement Application. [11] Matsutomo, S., et al., proposed a framework which gives vision in three dimensional space involving Hololenses to further develop the attractive field communication in the space, [12] Madhav Murthy, et al. fostered an AR device which has shown to be an a_ordable, e_ective and vivid method for showing designing drawing course [13]. Ghulamani, et al., proposed a utilization of Augmented Reality glasses to go to the talk on the web. Recording of talks is additionally accessible with the goal that understudies can go to the talks as indicated by their helpful time [14]. Wei, X., et al., elaborated a new teaching methodology which involves AR interactive class to teach students using this innovative technology. [15] Rezende, W.J. et al presented Augmented Reality Marker based techniques to educate children using mobile devices and to view images in books in 3D format. [16].

3. Implementation and Results

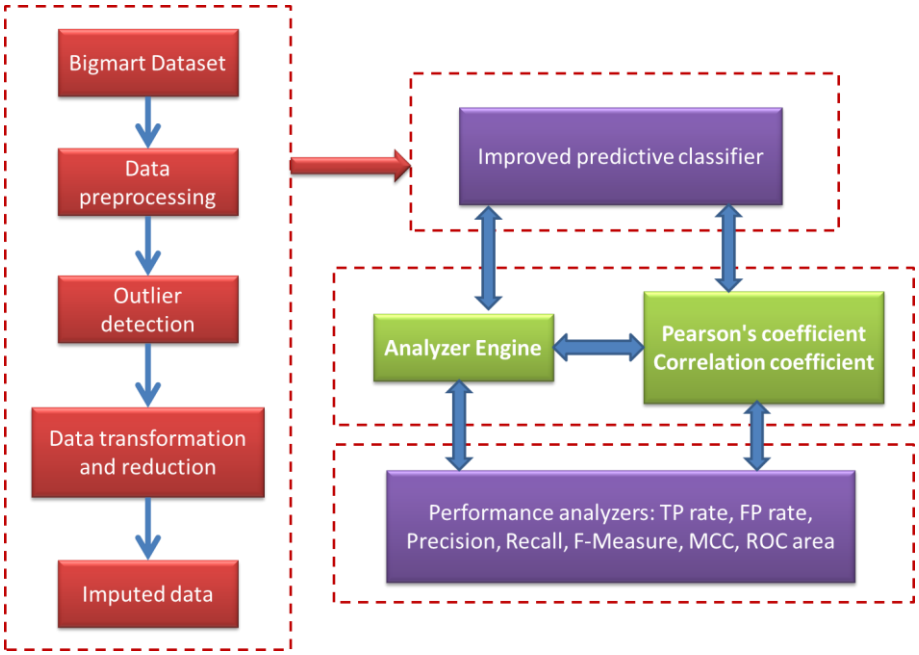

Figure1: Model for analysis & visualization of Bigmart dataset using mobile device

The model consists of a predictive classification algorithm which takes the pre-processed Bigmart dataset as the input and outputs the predictions into one of the three categories(healthy, unhealthy or both). Users of the program may observe the analysis of their data simply by downloading it from the cloud and installing it without having to read any extra documentation.

The dataset was transformed using data transformation techniques such as generalization, aggregation and smoothing. The dataset consists of 15 attributes inclusive of both the target and selected attributes, which then are inputted to a supervised learning algorithm. We were able to evaluate the influence of these characteristics on predictive classification by adjusting the hyper parameters. This dataset was processed and given as input to the Tableau big data analytics tool. Because of the complexity of the analytics obtained from Tableau, ML algorithms powered by Python seemed to be the better alternative for data visualization.

Nine different classifiers were developed and tested for this purpose, including J48 Decision Tree, Hefting Tree, Random Forest, Random Tree, REP Tree, Bayesian Network, Naive Bayes, OneR, and Decision Table. The final cleaned dataset is forwarded to our machine learning algorithms for classification with respect to item type, outlet size, and health status. The best predictive classifier from this peer group is recommended. The figure 2 compiles the classification results of all the different ML algorithms considered out of which the OneR algorithm performs the best.

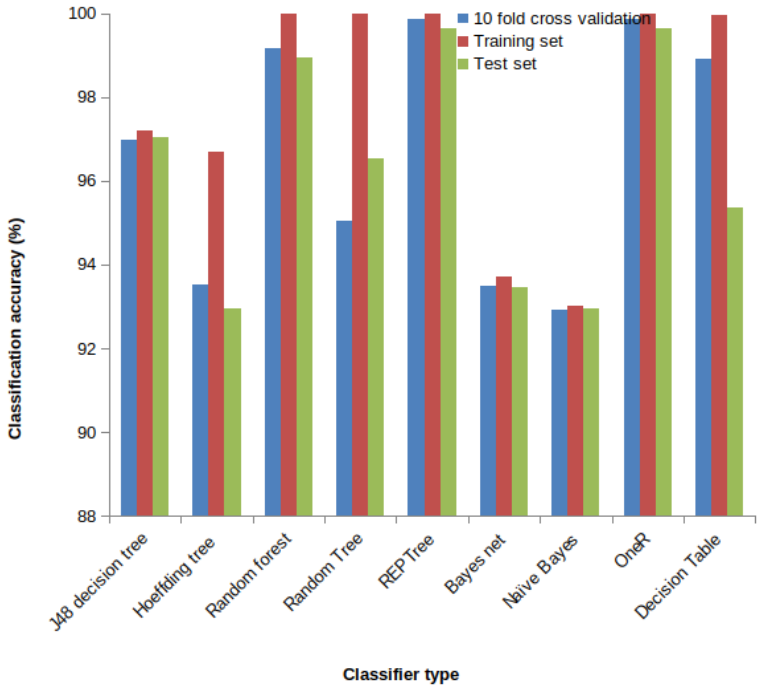

Figure 2: Classification result with respect to health status labels

The figure 3 shows a confusion matrix for classification using a OneR classifier that takes into account 10-fold cross-validation. A confusion matrix was calculated using the results of the OneR classifier to aid in performing a detailed assessment of the classifier and its results on 16 item types such as dairy products, soft drinks, meat, fruits and vegetables, household, baked goods, snack foods, frozen foods, breakfast, health and hygiene, hard drinks, canned foods, starchy foods, bread, seafood, etc were considered. This helps us understand classification and misclassification, by displaying classifier confusion matrix with the highest accuracy in a particular classification mode.

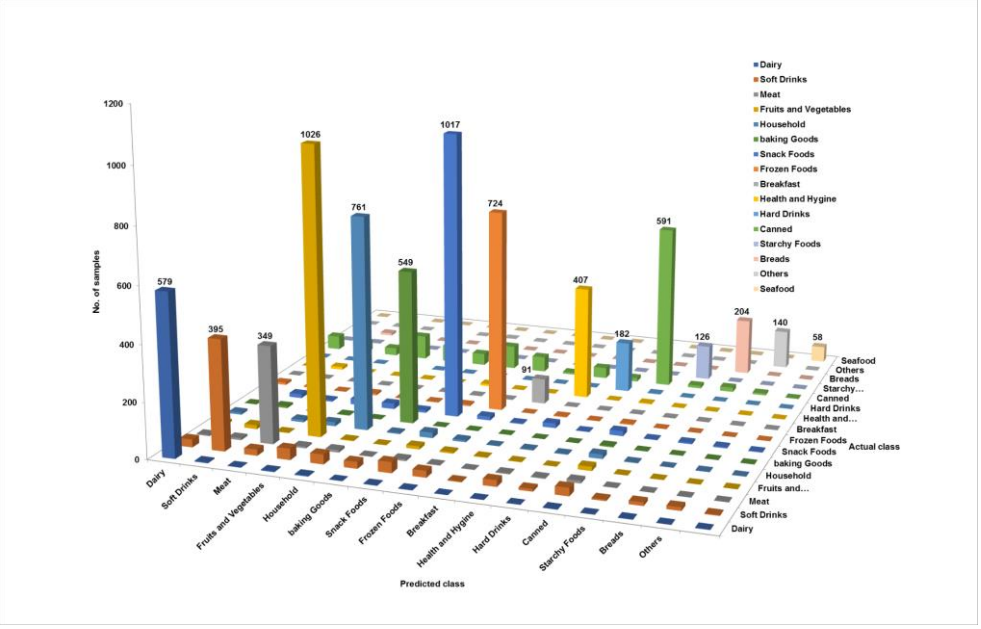

Figure 3: Confusion matrix for classification using OneR classifier considering 10 fold cross validation

Visualizations of these classifications are forwarded to the Unity engine for integrating it with the AR application and displaying 3D views to the end users. The VR plugin required by unity is vuforia and should be installed on unity.

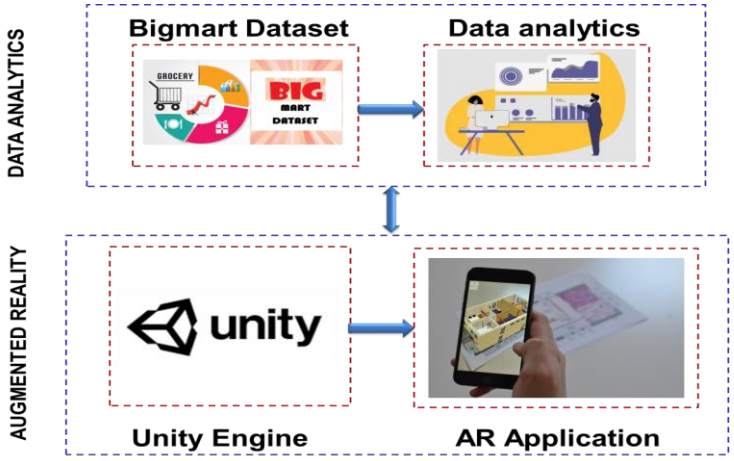

Figure 4: Tiers in implementation

The figure 4 shows the QR code required for augmenting the virtual information on top of the primary physical layer. Vuforia is an augmented reality SDK which primarily focuses on mobile applications. SDK is a combination of computer vision and machine learning which allows advanced artificial intelligence. Vuforia supports 2D and 3D targets including marker-based image targets. The image provided in the vuforia database is augmented by the engine itself through the target manager online. The QR code augmented in the vuforia engine is aligned with the 3D image imprinted on the smartphone device as shown in figure 5. The augmented information is a surface view of the products with low, medium and high fats, proteins, carbohydrates. The surface view is a better visualization when comparing healthy and unhealthy food products. . 2D visualization in the form of pie-charts, bar-graphs, and maps on the User interface can be visualized. An application package file compatible with smart devices developed in Unity IDE. Augmented 3D visualization with the help of vuforia plugin in

Unity IDE. The targets updated for AR marker-based image.

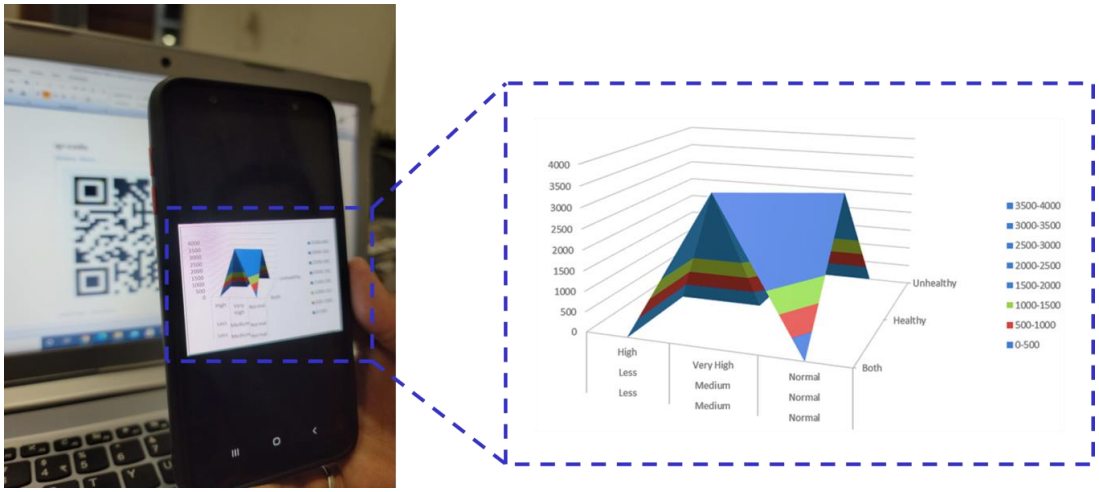

Figure 5: Output Applying Improved Predictive Indicator Algorithm

In the table 1, the iterations for each optimizer varied from 10 to 200 and epochs varied from 10 to 100. For elephant herding optimization it was found that when 'Itr' was 50 and 'Epo' was 50, clans was 10, alphas was 0.1 and beta was 0.2, accuracy was 90.1245% (10 fold cross validation), 95.2518% (Training set), 89.2358% (Test set). For monarch butterfly optimization it was found that when 'Itr' was 32 and 'Epo' was 50, p was 4/12, peri was 1.2, BAR was 7/12 and Smax was 50, accuracy was 92.3258% (10 fold cross validation), 96.8888% (Training set), 90.2145% (Test set). In comparison of 4 optimizers, Monarch butterfly optimization yields highest accuracy for 10 fold cross validation, training set and test set. Owing to optimization study, the accuracy has increased.

Optimization algorithm	Common constraints	Algorithm specific constraints	10 fold cross validation	Training set	Test set
Elephant herding optimization	$Itr = 50$ $Epo = 50$	$clans = 10$ $\alpha = 0.1$ $\beta = 0.2$	90.1245	95.2518	89.2358
Monarch butterfly optimization	$Itr = 32$ $Epo = 50$	$p = \frac{4}{12}$ $peri = 1.2$ $BAR = \frac{7}{12}$ $S_{max} = 50$	92.3258	96.8888	90.2145
Harris hawks optimization	$Itr = 100$ $Epo = 50$	-	86.3547	90.3189	85.6574
Slime mould algorithm	$Itr = 50$ $Epo = 50$	$z = 0.1$	85.2361	88.3254	86.2148
Elephant herding optimization	$Itr = 50$ $Epo = 50$	$clans = 10$ $\alpha = 0.1$ $\beta = 0.2$	90.1245	95.2518	89.2358

Monarch butterfly optimization	$Itr = 32$ $Epo = 50$	$p = \frac{4}{12}$ $peri = 1.2$ $BAR = \frac{7}{12}$ $S_{max} = 50$	92.3258	96.8888	90.2145
Harris hawks optimization	$Itr = 100$ $Epo = 50$	-	86.3547	90.3189	85.6574
Slime mould algorithm	$Itr = 50$ $Epo = 50$	$z = 0.1$	85.2361	88.3254	86.2148

Table1: Optimized classification result with respect to outlet size labels (OneR classifier)

4. Conclusion

A detailed design, analysis & visualization of Bigmart dataset using marker-based augmented reality and mobile devices is presented. The 'Bigmart' dataset was considered and provided as an input and classification with respect to item type, outlet size, and health status using machine learning is presented using different classifiers such as J48 decision tree, Hoeffding tree, Random forest, Random Tree, REPTree, Bayes net, Naïve Bayes, OneR, and Decision Table. The methodology clearly classifies and visualizes the data appropriately in 3D form. The confusion matrix in 3D form is clear, easy to understand classification and misclassification. To improve the classification accuracy the four meta-heuristic optimizers were employed that assists hyper parameter tuning in a systematic way. The methodology clearly classifies and visualizes the data appropriately in 3D form. The confusion matrix in 3D form is clear, easy to understand classification and misclassification. The oneR classifier along with Monarch butterfly optimization is recommended for classification of item type and outlet size Bigmart data.

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