International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8, Issue-1, May 2019

Smart Glass Based Augmented Reality For Warehouse Management

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Abstract: ***Augmented reality has been widely used in many applications because of its ability to offer an amazing way to overlay computer-generated images over the user's real-world view, creating a composite view rooted in real and virtual worlds. Augmented Reality is a realistic, direct or indirect view of the physical reality environment whose elements are enhanced through computer-generated or sensory input such as sound, video, graphics, tactile, or GPS data. In this paper we propose a smart AR enabled glass for warehouse management. With the help of AR technology, each and every item in the warehouse, which is mapped, can be reached easily by user by navigation. The glasses can reduce the extra effort of inventory management by using Firebase ML Kit to detect the product and automatically make changes in the inventory database. These glasses do not require any prior training and thus it reduces the training hassle for the new employees. This these glasses can make way for an easier and smoother warehouse management.***

Keywords: Augmented reality, warehouse argument reality, internet of things, smart glass, smart warehouse, smart inventory management.

I. INTRODUCTION

Augmented Reality is an interactive way to add the virtual and real world. AR technology can be used in lot of fields like teaching, medication, servicing or maintenance, entertainment, as a route guide or anything which can be presented through visuals in real world. AR is one of the best ways to teach and give instructions to the fellow people, it leads to better understanding and guidance of the environment and with less efforts. The chances of errors also reduce and gives the better results. Here main focus is on large scale warehouse management where all the goods have some specific place and details to work with, the worker will use the AR to get guidance and instructions to work with goods which includes guiding the route to where the good belongs then the details of that good then if it has to be replaced or have be placed. There can also be done the maintenance work in the warehouse for the goods or the warehouse itself. This will lead to low cost, better understanding for the new workers, the better management of the warehouse and reduce the time consumption.

Revised Manuscript Received on 30 May 2019.
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II. RELATED WORK

[1] Industrial Augmented Reality Systems for the Industry 4.0 Shipyard It provides thorough comparisons on the latest hardware and software technologies for creating IAR solutions. It proposes a novel IAR architecture that makes use of Edge Computing to reduce latency response and accelerate rendering tasks. Fog gateways are usually constraint in terms of computing power. If an IAR system demands real-time rendering or compute-intensive services, Cloudlets are necessary.

[2] Guiding People in Complex Indoor Environments Using Augmented Reality Complex public buildings like airports use various systems to guide people to a certain destination. Such approaches are usually implemented by showing a floor plan, having guiding signs or colour coded lines on the floor. With a technology that supports 6DOF tracking in indoor environments it is possible to guide people individually by using augmented reality guiding visualizations. The tracking and the guiding part of the 3D model was not reliable.

[3] A novel campus navigation APP with augmented reality and deep learning The App uses augmented reality to provide users with a new and interesting way to meet the campus. A virtual terrain modeling interface with deep learning is used to improve the object recognition ability. The efficiency of the navigation system was poor. The information about the campus environment and its objects was not accurate.

[4] House Hold Guide Using Augmented Reality The house hold guide will teach you the whole procedure on how to fix the house hold problem step by step using AR. The procedure of fixing any house hold equipment has to be first fed into the device, only then it can be used. After the device is taught with the procedure, it will guide the user when he comes across the problem while using that device.

[5] The use of augmented reality in the maintenance of mechanical objects It uses AR to provide guidance to engineers as they carry out maintenance activities on equipment. This improves the quality and accuracy of maintenance activities as per the original equipment manufacturers (OEM) instructions. This small investment in technology can have an effect of increasing machine life, reduce machine downtimes as maintenance is performed faster and make economic sense in the long term.

[6] Mobile augmented reality on web-based for the tourism using HTML5 This research presents the development of the augmented reality (AR) for the tourism in Lopburi ancient city. The main objective is to inform the attraction place's data to the tourist. The interaction with the tourist and the environment is possible in the real time. There are many AR platforms which can be used for the various functions.

The advantage of HTML5 is that the users can access the application immediately without installation application required. This research uses HTML5 and JavaScript to develop the augmented reality into web-based for support of mobile devices

III. PROPOSED SYSTEM

The proposed system is a smart glass based on Augmented Reality for warehouse management system. The AR technology here will be used in lot of ways, as a route guide or anything which can be presented through visuals in real world. The glass will also have a camera and HUD display which will scan and display the results. The glass will perform following steps:

1. Camera to scan the image or QR code.

2. The scanned data will be matched to the database and the expected results will be given (routes, product info, steps for handling products).

3. The navigation will be displayed in the HUD display for the worker.

Many other maps, info and navigations can stored manipulated easily by the admin interface. This model can be manipulated for many other functions in various other fields to guide the person or for individual use.

A. *System Architecture*

The system follows a client server model with the warehouse management system as the server and the smart glass as the client. The smart glass access can the data from the system only by the predefined system rules and format.

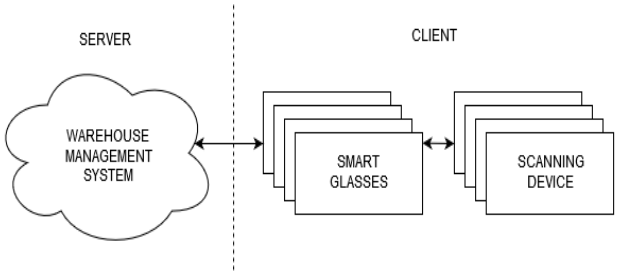

Fig. 1. System Architecture

B. *Smart Glass Components*

The smart glass is built on a single micro controller which connects the components which include microphone, heads up display, camera and a battery pack.

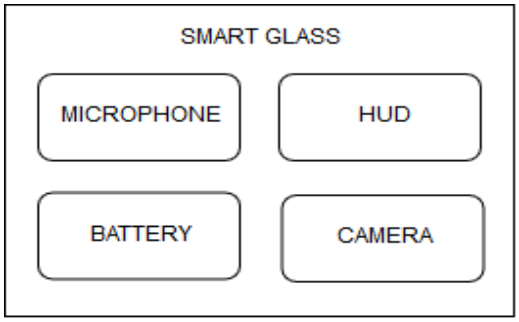

Fig. 2. Smart Glass Components

IV. MODULES

A. *Barcode scanning*

The smart glass constantly uses the camera of the device in order to continuously get live images. These images are processed and the data in the barcode is identified. The Barcode scanning is done with the help of the Barcode Scanning API of the Firebase ML Kit.

ML Kit makes it easy to apply ML techniques in your apps by bringing Google's ML technologies, such as the Google Cloud Vision API, Mobile Vision, and TensorFlow Lite, together in a single SDK. Whether one need the power of cloud-based processing, the real-time capabilities of Mobile Vision's on-device models, or the flexibility of custom TensorFlow Lite models, ML Kit makes it possible with just a few lines of code.

The 1D barcode is generally used for product tags and so the 1D barcode is always identified as a product. The 2D barcode or QR code is taken as a location tag which is used for navigation purpose.

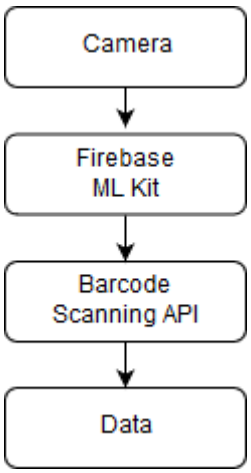

Fig. 3. Barcode Scanning Workflow

B. *Navigation to product*

This module helps with navigation by providing the exact directions to the product which is required. This is done by dividing the whole warehouse into rows and columns making it as a big graph. Each row and column has its own identification which is labelled by QR code. The intersections of the rows and columns act as the nodes of the graph.

The smart glass constantly uses the camera in order to continuously get live images. The current location of the user is identified by using the row and column matrix. The location of the product is determined from the warehouse database system, which includes the rack label for each product.

The QR code scanned translates into row and column number and identifies the node. The navigational path from the user's current location to the product location is determined by using shortest path algorithm on the whole graph of the warehouse. The shortest path algorithm used is the Dijkstra's algorithm. It is used as only the shortest distance from one point to another is required.

Further each rack in the warehouse is assigned a number and labelled with a QR code. This provides the user precise direction to the exact rack in which the product, the user is searching for, is present.

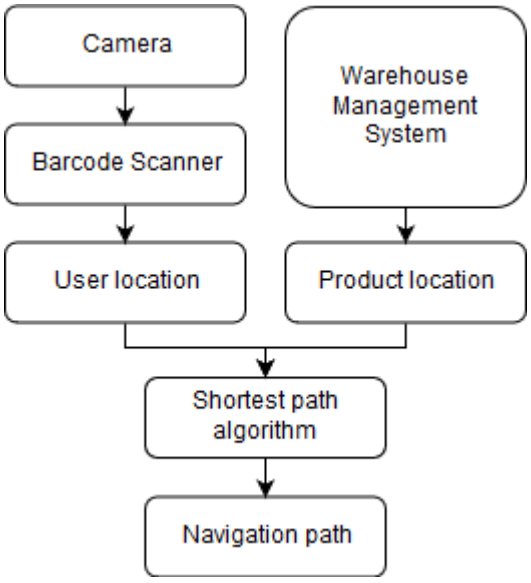

Fig. 4. Navigation Workflow

C. Pick by vision

This module is responsible for proper product identification and real time updation in warehouse management system. It ensures that the user is picking up the exact item which is required and nothing else. Each product is assigned with a barcode in each warehouse already. When the user reaches the destination and picks up the product, the barcode scanner module is used to determine the product ID and is cross checked with the ID of the required product.

If the product ID obtained by scanner and the required product ID match then the user is informed by the HUD that the product picked up is correct and the user can proceed further. Else the hud displays an error and encourages the user to check and pick correct product.

Once the verification for the correct product is done, the smart glass also updates the database or inventory in the warehouse management system. The smart glass acts as just another client for the warehouse management system and accesses the database in same way as other clients. Each smart glass is assigned with login credentials to the system and only an authorized user with these credentials can access and update data in the system. The smart glass can be integrated with various warehouse management system available in the market making it independent of the type of warehouse management system. This way ensures that the existing security measures of the warehouse management system owned by the company is strictly followed.

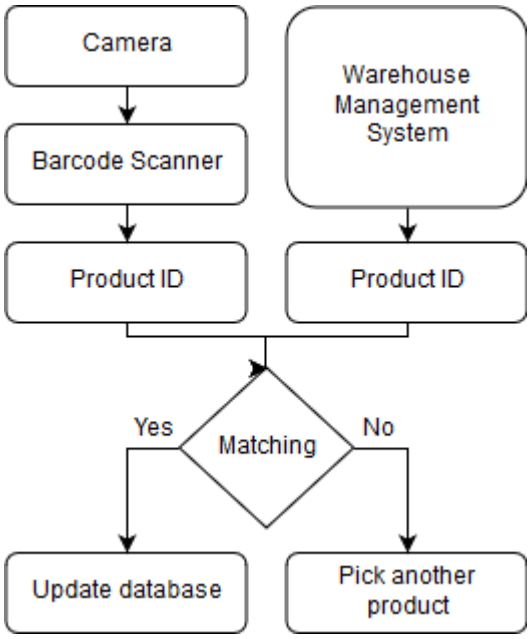

Fig. 5. Pickup and Update Workflow

D. Heads Up Display (HUD)

The heads up display uses a transparent oled screen for each eye glass lens. The transparent oled display allows for an immersive and realistic AR projection. Since the glass lens is itself self illuminating and does not require any additional sources, it makes the smart glass very light and compact.

The HUD displays the direction or the navigation path to the user in AR. Each and every direction is displayed and it is made sure that the view of the user is not obstructed. The HUD also displays other information and gives hints to the user in form of scanning animation, check marks in case of correct product pickup, cross marks in case of wrong pickups, product details like product ID and name and successful updation of database notifications.

The HUD guides the user and makes the smart glass very friendly, easy to understand and operate.

E. User Interaction - Microphone

The microphone attached to the smart glass will used to take in voice commands from the user. The voice commands are the way of interaction between the smart glass and the user. The voice commands are required to search for a particular item and also update the inventory.

Noise cancellation microphone pairs are used to reduce the noise of the warehouse environment.

V. COLCLUSION AND FUTURE ENHANCEMENTS

This paper proposed an accurate method for detecting items in the warehouse where finding an object becomes haywire for an individual. The smart glass can help with navigation to the item placed in the exact position of the rack using simple signals in conjunction with the inbuilt camera, vision recognition framework makes use of sensor values and artificial tags distributed throughout the warehouse that allow for determining the positioning of the item in the warehouse. This use case is intended to assist warehouse operators in the processes of storage, localization, relocation and collection of parts. The immediate advantage of displaying information on the smart glass will decrease in human errors and in the time associated with the different processes involved in the management of the warehouse. In future more security can be given in accessing the database during transactions. Also this glass can be used in many other large scale industries where human error occurs. Since the system works with the barcode, this needs to be fed in the system. In future GPS data can be used to access the items.

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