

3D BIM Model Utilization in Augmented Reality

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ABSTRACT: With faster development of the country, construction is in full speed. In recent days construction industry has adapted various innovative advancements, so as to make construction better and faster. One among this innovative advancement is augmented reality. Managing piles of drawing sheets at site has been challenging. Combining augmented reality with 2D and 3D models, bringing drawing and plans to site easier. With augmented reality models can be used at any spot in site for cross reference and comparison. This paper describes an attempt to bring various 3D BIM models into augmented reality platform.

KEYWORDS:BIM, 3D models, augmented reality.

I. INTRODUCTION

Building plans are the arrangement of drawings which comprises of floor plan, site plan, cross areas, rises, electrical, plumbing and scene drawings for the simplicity of development at site. Drawings are the vehicle of passing the perspectives and ideas of a draftsman or originator into the real world. Creating 2D drawing has evolved from manually drawing plans on large drawing sheets to creating plans using software's, even creating 3D models of the plan. But visualizing these plans on site is challenging. Information from 2D drawings is presented two dimensionally, which makes it particularly difficult to present spatial associations between building segments in an authentic three dimensional (3D) condition. The innovation of abusing 3D models for investigating building data has as of late picked up fame, as personal computers are progressively ready to help illustrations that are more modern ^[1].

Nowadays, Building Information Modeling (BIM) empowers the profitable and particularly beneficial multi-capable joint exertion. By synchronizing the focal records, different experts can have similar informational index and work on a brought together stage. It is seen that the particular segment of BIM is incorporated 3D recognition and the contrasting structure data the chiefs segments. Most importantly, with 3D representation, it is simpler to show plan expectation of cross-disciplinal expert architects and empower instinctive comprehension, encourage opportune correspondence and blunder checking in drawings. Arranging the 3D models of BIM with the savvy structures can re-authorize abrupt conditions by PC and exchange game-plans can be made early. What's more, using the 3D representation innovation of BIM, the development unit can distribute venture development information and operational information through the web and different methods for broad communications. In any case, nearby utilization of work stations isn't especially practical as a result of their helpless compactness ^[2].

Bringing 3D models into workplace requires expanded reality support. Expanded reality (AR) is a natural encounter of an authentic space where the articles that stay in fact are improved by PC made perceptual information, by and large over different undeniable modalities, including visual sound-related, and so forth. AR can be described as a structure that fulfils three fundamental features: a mix of veritable and virtual universes, continuous affiliation, and careful 3D enrolment of virtual and certified articles. The overlaid generous information can be significant (for example added substance to the indigenous common environmental factors), or ruinous (for example covering of the ordinary condition). This experience is flawlessly gotten along with the physical world so much, that it is seen as a striking bit of the bona fide condition. Hence, expanded reality changes one's propelling point of view on an authentic situation, anyway PC made reality completely replaces the client's genuine condition with a repeated one. The paper is an attempt to create 3D BIM models of house and other interior components, upload them into an augmented reality platform and view them in real environment using mobile augmented reality application ^[3].

II. RELATED WORK

Using an enlarged reality wearable PC, Jiao Piekarski et al. developed an item system, known as Tinmith-Metro. Tinmith-Metro licenses customers to control a 3D beneficial solid calculation modeler for building graphical objects of

colossal physical doodads, for example structures, in the physical world. The 3D modeler is driven by another UI known as Tinmith-Hand, which allows the customer to control the modeler using a great deal of press gloves and hand following. These methodologies license customer to smoothly their AR renderers with models that would in advance should be gotten with manual, monotonous, and/or exorbitant strategies. These new techniques have been executed in a display structure known as Tinmith-Metro, considering the Tinmith evo5 programming plan. An important part of this structure is it allows the customer to ostensibly affirm the article's precision at creation time, and grant others to see them on indoor VR or work territory systems consistently, or soon^[4].

Chen Ye et al. developed a wearable contraption that can expand the improvement drawings and related data dependent on the necessities of the customers. This device consolidates four modules: one-the data fuse module is used to move data in the structure data model (BIM) into pictures. Two-The position module engages customers to incorporate their regions and therefore search for the photos that the customers may require. Three-The control module can eviscerate the indications of the clients from the touch screen and accelero-meter in the gadgets, and from there on crop the photographs to take out the unneeded information. Four-The presentation module, which direct relationship with the projector, can constantly figure the photographs organized by the past three modules and scale the photographs in like manner. A gear device, the iHelmet, has in like manner been made to execute the four modules. It involves an improvement head protector, an iPod Touch, and an Optima light-communicating diode (LED) projector. To affirm the usability a customer test with 34 individuals was driven. The results exhibited that the mean accomplishment paces of individuals appearing at the correct answers were in a general sense improved for those using the iHelmet^[5].

Wang et al. spread a sensible framework that joins BIM and AR for use being developed. The structure includes three layers: (1) BIM, (2) AR following/identifying for setting careful and (3) AR observation/cooperation. The accompanying/distinguishing for setting careful is respected to be basic for engaging portrayal, yet also for dynamic needing to occur. According to maker while BIM can be used to improve the capability and feasibility of structure coordination, it can't consider the inherent weakness related with design changes and alter, which win during advancement, particularly in complex endeavors. The usage of an inbuilt setting care and information layer gives a phase that can couple BIM and AR with the objective that data about 'as-made and as-masterminded progression's and 'current and future headways can be gotten and presented apparently^[6].

The encounters of **Meza et al.** with the model shows building information models can reasonably showed up in an AR condition. Sorting out time piece with 3D math has demonstrated to be a dull undertaking, considering the way that each and every section must be associated with precisely one activity. One of the basic factors is in like way the apparatus uttermost ranges of telephones. Tests have shown that size of models must be reduced in the event that one needs to show them on PDAs. Given the way that CBSE was utilized to build up the framework, it emits an impression of being sensible to bring up its most feeble part. As for the current relationship of the framework the makers recognize that the most vulnerable section is the advantageous AR application Layer. In any case, the makers had the choice to show that AR can give unhindered access to information from building information models at some sporadic time. Astonishingly more, not entirely it is even conceivable to streamline the checking of the progress of the improvement experience. (1) The model permits the client to consider the certified state on the structure site with the one in the timetable with no printing of the documentation and (2) clients are not compelled to utilize their spatial mindfulness in regards to look at the plans and the authentic condition of the improvement experience. They essentially need to point the cell phone in the ideal bearing and they rapidly get the information whether the progression experience follows the ideal arrangement or not^[7].

Williams et al. contribute a helpful and financially sharp reaction for sort out BIM into MAR by stirring up a procedure and work process that pros can use to combination, advance, and envision their information and models in a MAR situation. BIM2MAR adds to the AECO space's store of information, in that it gives an unmatched comprehension of how monetarily BIM and MAR can be encouraged to ask access to information. WebGL and THREE.js, Web rules utilized by most helpful tasks, are utilized requiring no extra module establishment or cost. At long last, this is the basic stage in stirring up a completely modernized BIM2MAR process for different AECO applications. In a completely computerized BIM2MAR process, all math and information would be open through a constant information/yield structure and the AR condition would strengthen thusly as changes are made to the BIM^[8].

A BIM-based and augmented reality (AR) application (alluded to as the AR4C: Augmented Reality for Construction) is proposed by **Ratajczak et al.** which incorporates an area based management framework (LBMS). The application gives setting specific information on development activities and errands, just as key execution markers on the advancement and execution of development assignments. The development ventures are superimposed onto this present reality, while a site administrator is strolling through the building site. The application furnishes clients with

setting specific information identified with development ventures utilizing AR, similar to 3D models, geometrical and specialized highlights of building parts and materials, arrangements of development undertakings, establishment techniques, development agendas and development progress and execution measurements. The benefit of this innovation is to screen and control development undertakings in different areas while the site supervisor is performing field examination^[9].

Samant et al. examination accomplished virtual home programming by utilizing the strategy for 3D remaking to obscure scene to execute camera 3D enlistment, did a necessary investigation to this sort of Augmented Reality System dependent on no markers. To start with, compute the component focuses coordinating pair of two key casing pictures, in this procedure the creator utilized the strategy for consolidating FAST corner and ShiTomasi corner to make the coordinating and following procedure progressively stable as per the preferences and burdens of highlight focuses location administrator talked about previously. Next, assess the basic network as indicated by five-point calculation, figure the camera's outer boundary framework, decide the camera's underlying posture and triangulate as per the posture of camera to compute the 3D map focuses. Include the guide focuses via looking through polar line, register noteworthy plane as indicated by the acquired guide focuses, change the guide focuses and camera posture to the huge plane, total introduction phase of the framework. Next as indicated by the guide focuses at first created, match and track it, update the camera's posture, and afterward update the guide however the posture and added key edge picture to understand the ongoing posture refreshing of the camera. Finally, we use Unity3d Vuforia to model and to render, making the virtual and reality coordinate^[10].

Phan et al. exploration inspected virtual furniture and change work to make another structure technique utilizing Augmented Reality innovation for Interior Design training. In an AR situation, structure work can turn out to be all the more energetic, advantageous, and smart. Besides, plan work and assembling can be directed simultaneously and we cosy relationship with one another. With AR, the virtual results of realistic innovation are for recreation as well as acquire genuine higher qualities. Moreover, AR innovation can turn into another vivified reproduction instrument for inside plan, permitting the client to see a blended AR scene through HMD, video show, or PDA. It is likewise foreseen that the intelligent potential can be expanded by the client's needs^[11].

Pampattiwar et al. utilized marker based AR for executing another plan approach for inside structure. This AR condition will allow the customer to look over an extent of furniture and subsequently show the virtual furniture picked on the real condition. The customer can in like manner change the virtual furniture continuously on the screen allowing the customer to have a clever inclusion in the furniture in a genuine area. This will give an unrivaled point of view on the furniture circumstance and revamp the strategy of inside organizing for customers to save their time and effort. The outcomes indicated that furniture were rendered on the marker and scaled in like manner. The size of the article relied upon the size of the marker and the good ways from the camera. The clients could control the items and spot them as indicated by the scene. Likewise, the UI is straightforward permitting amateurs just as expert clients to utilize the application^[12]

III. METHODOLOGY

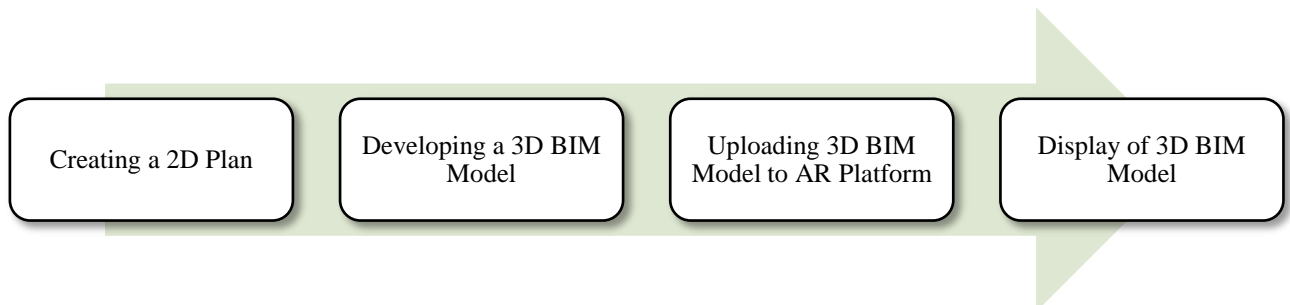


Fig.1. Flow of Work

Various BIM 3D models were created using AutoCAD, 3ds max and Revit architecture software's. They were uploaded into augmented platform and viewed using mobile augmented reality application.

Stage 1: 3D model of a house.

Stage 2: 3D model of table and chair.

Stage 3: 3D model of an office cabin components.

Stage 4: 3D model of a house with interior view, exterior view and complete view.

2D plans were created using autocad-2015 software.

- Set units: type “un” in comment box > display of units setting box > set required unit settings > ok.
- Set dimension style: type “dimsty” in comment box > display of dimension style setting box > set size colour of text, lines, arrows etc.
- Drawing walls: select line > draw for required length > use offset for wall thickness.
- Placing components: create door, window and ventilation component > save them as blocks > load them and place at required position.
- Adding text: select multiline text > type required text > adjust the size of text > place it at required.

3D models of houses were created using Revit architecture software.

- Initial Setup: open Revit software > select architectural template > set units.
- Setting Levels: go to elevation > set required number of levels.
- Importing Plan: go to insert > select import CAD > choose the file > enter.
- Drawing walls: go to architecture > select wall > edit type > duplicate the wall> edit wall thickness > draw walls > set base level and top level.
- Drawing floors: go to architecture > select floor > draw boundary lines > ok > set base level and top level.
- Placing doors: go to architecture > select doors > load family > choose the required door > load to project > edit type > duplicate the door > edit dimensions as per requirement > place the door at required position> set base level and top level.
- Placing window: go to architecture > select window > load family > choose the required window > load to project > edit type > duplicate the window > edit dimensions as per requirement > place the window at required position> set base offset > set base level and top level.
- Drawing roof: go to architecture > select roof > draw boundary lines > ok > set slope of roof > set base level and top level.
- Drawing ceiling: go to architecture > select ceiling > draw boundary lines > ok > set base level and top level
- Drawing sunshade: go to architecture > select floor > edit type > duplicate floor and rename it > edit thickness > draw boundary lines > ok > set base offset > set base level and top level.
- Drawing staircase: go to architecture > select stair > sketch the stair > ok > set base level and top level

3D models of chair, table and office components were created using 3ds max.

Each model requires a marker so as to be displayed in real environment. These markers can be any image with more than 1000 tracking points. To make markers compatible to AR platform (unity) vuforia is used. Both 3D model and tracker is uploaded to AR platform (unity), model is placed above the tracker and minor adjustment are made. The finished file is exported into android platform (mobile phone) as an application and installed. When the application scans the marker 3D model is displayed.

IV. EXPERIMENTAL RESULTS

Stage 1: 3D Model of a House

Fig.2 shows models of house created in Revit. Fig.3 shows model of house displayed in augmented reality view. The marker is placed on the floor and scanned through mobile phone application. Texture of the model could not be loaded into AR platform. Model is small when compared to tracker.

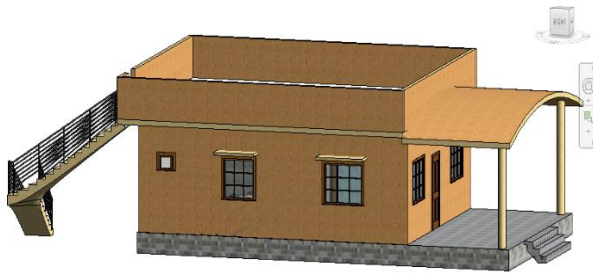


Fig.2. 3D Model of House

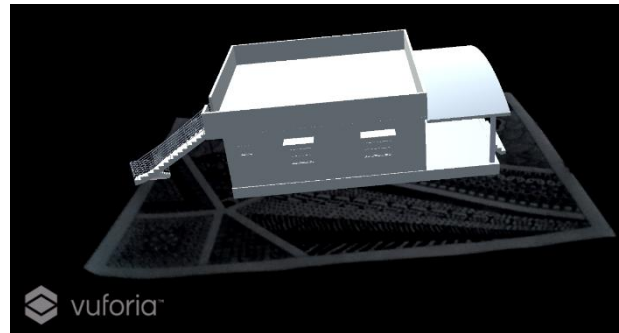


Fig.3. 3D Model of House in AR view

Stage 2: 3D Model of Table and Chair

Fig.4 shows the model of table and chair created in 3ds max. Fig.5 shows the model of table and chair displayed in augmented reality view. The marker is displayed on the ground and scanned through mobile phone application. Texture of the model is applied in AR platform since it could not be loaded. Model is big when compared to tracker. Since model is bigger than tracker complete model is not displayed.



Fig.4. 3D Model of Table and Chair



Fig.5. 3D Model of Table and Chair in AR View

Stage 3: 3D model of an office cabin components.

Fig.6 shows the model of office cabin created in 3ds max. Fig.7 shows the model of office cabin displayed in augmented reality view. The marker is displayed on the floor and scanned through mobile phone application. Texture of the model is applied in AR platform since it could not be loaded. Model is big when compared to tracker. Since model is bigger than tracker complete model is not displayed.

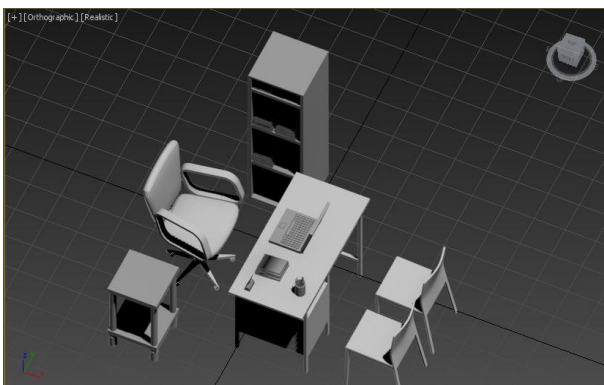


Fig.6. 3D Model of Office Cabin Components



Fig.7. 3D Model of Office Cabin Components in AR View

Stage 4: 3D Model of a House with Interior View, Exterior View and Complete View.

Fig.8 shows the model of house with complete view created in Revit. Fig.9 shows the model of house with complete view displayed in augmented reality view. Fig.10 shows the model of interior of house with created in Revit. Fig.11

shows the interior of house displayed in augmented reality view. Fig.12 shows the model of house with complete view created in 3ds max. Fig.13 shows the model of house with complete view displayed in augmented reality view. Fig.14 shows the model of interior of house with created in 3ds max. Fig.15 shows the interior of house displayed in augmented reality view. The markers are printed on A4 sheet and scanned through mobile phone AR application. Texture of the models could not be loaded into AR platform, it was added separately on AR platform. Models are fitted exactly on the marker. Display of models are exact to markers.

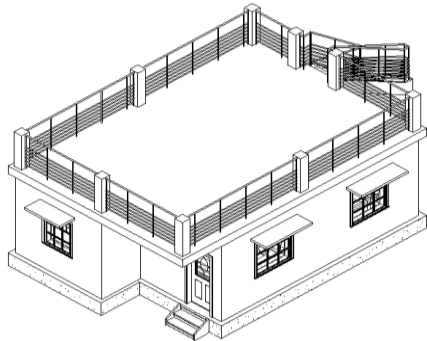


Fig.8. 3D Model of House [complete view]

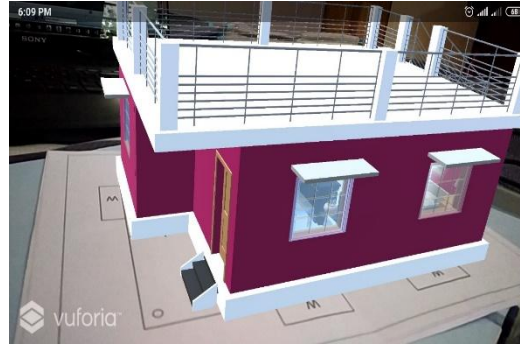


Fig.9. 3D Model of House [complete view] in AR view

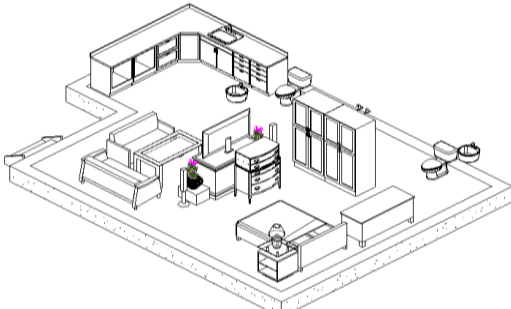


Fig.10. 3D Model of House [interior view]



Fig.11. 3D Model of House [interior view] in AR view

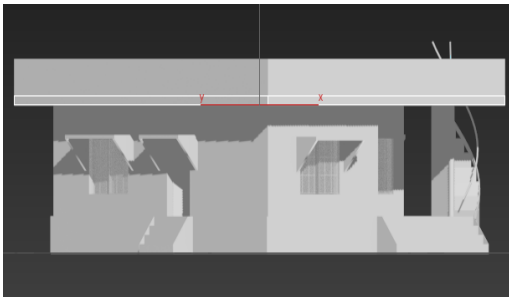


Fig.12. 3D Model of House [complete view]

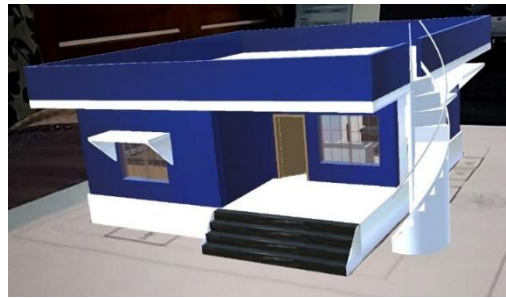


Fig.13. 3D Model of House [[complete view] in AR view

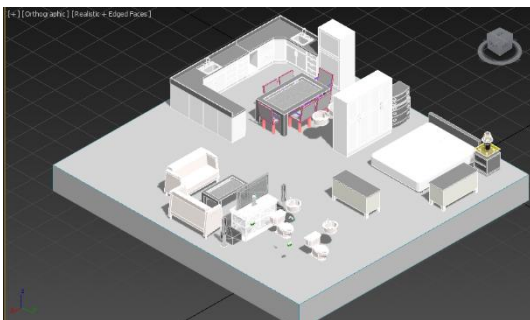


Fig.14. 3D Model of House [interior view]

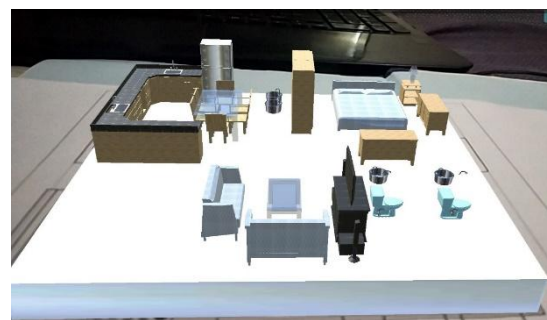


Fig.15. 3D model of House [interior view] in AR view

V. CONCLUSION

Augmented reality has become a trending topic in research and innovation fields. It has numerous applications in various fields such as medical training, repair and maintenance, design and modeling, business logistics, tourism,

classroom education, field services, entertainment, etc. Using augmented reality technology in construction field makes hard works easier. It helps in greater coordination between office and site. When models and drawings can be accessed on site work process becomes faster and accurate. It has a lot of scope in coming days and lot of improvement has to be done to present study scenarios.

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