Virtual Healthcare Navigator

Gunaseelan R[1], Manikandan M, Manikandan S, Dr. Geetha K[4]
[1]Dept. Information Technology (IT) M.A.M College of Engineering and Technology (MAMCET)
(Anna University of Affiliation) Trichy, India
[2] Dept. Information Technology (IT) M.A.M College of Engineering and Technology (MAMCET)
(Anna University of Affiliation) Trichy, India
[3]Dept. Information Technology (IT) M.A.M College of Engineering and Technology (MAMCET)
(Anna University of Affiliation) Trichy, India
[4]Dept. Information Technology (IT) M.A.M College of Engineering and Technology (MAMCET)
(Anna University of Affiliation) Trichy, India

Abstract— In an era marked by delays in prompt medical care, In this paper stands as a beacon of change, introducing a cutting-edge solution for rapid and precise access to healthcare services. Leveraging Virtual Reality (VR) technology, we aim to minimize treatment delays, alleviate patient distress, and enhance overall healthcare delivery. Our mission is to transform healthcare encounters, expediting medical assistance, mitigating suffering, and fostering a superior healthcare environment. Central to our approach is the integration of QR codes with AR/VR technology, a universal solution with the potential to benefit diverse groups regardless of their background or medical needs. This paper explores the objectives, methodology, and broader implications of our innovative work, striving to redefine the healthcare landscape and make a profound impact on healthcare accessibility and quality. In this paper also incorporates QR code scanning to enable users to accurately locate hospitals and access medical services.

Keywords: Virtual Reality (VR), Healthcare accessibility, QR code technology, Medical assistance, Hospital

I. INTRODUCTION

In today's healthcare landscape, delays in receiving timely medical treatment are a significant challenge. In this paper aims to develop a solution that ensures swift and accurate access to care, thereby enhancing people's healthcare experiences. By leveraging advanced Virtual Reality (VR) technology, we are dedicated to reducing treatment delays, alleviating patient suffering, and ultimately enhancing the overall quality of healthcare delivery. [1] The primary objective of our endeavour is to transform the healthcare experience by revolutionizing how medical care is accessed and delivered. Through the integration of VR technology, we are pioneering a new approach to healthcare that prioritizes efficiency, accuracy, and patient comfort. In this paper aims to reduce the stress and uncertainty associated with seeking medical treatment by streamlining the process of accessing care.

Fig.1.1 People in Hospital

Additionally, Fig 1.1 shows we seek to improve the overall quality of healthcare delivery by ensuring patients receive the right care at the right time. A key feature of our initiative is the use of VR technology to create immersive and interactive healthcare environments. VR simulations provide patients with a more realistic and informative experience, aiding in their understanding of medical conditions and treatment options. [2] This approach empowers patients to take a more active role in their healthcare decisions, leading to improved outcomes. Furthermore, this incorporates advanced technologies such as QR codes to enhance the accessibility of healthcare services. QR codes enable patients to easily access information about treatment options, locate medical facilities, and schedule appointments. This technology is particularly beneficial for individuals with limited mobility or access to healthcare services, facilitating more efficient and effective care delivery. [3] Additionally, it includes QR code navigation to critical areas in hospitals, ensuring timely access to medical care and potentially avoiding deaths. In conclusion, our initiative represents a significant advancement in healthcare technology, offering a solution with the potential to improve the lives of millions worldwide.[4] By

leveraging VR technology and advanced digital solutions, we aim to create a future where healthcare is more accessible, efficient.

EASE OF USE

The proposed paper is all about making healthcare technology easy and inclusive for everyone. We believe that technology should be accessible to all, no matter how much you know about it. To make this happen, we've included a bunch of features that make our system easy to use. [5] For example, our Virtual Reality (VR) interface is designed to be simple to navigate, like taking a relaxed walk through the hospital. We've also added QR codes, so you can quickly scan them to get the information you need. Language isn't a problem either, as in this paper supports multiple languages. We've also made sure to include guides to help both hospital staff and visitors learn how to use the system. Plus, In this paper works well on different devices like VR headsets or mobile phones. [6] Overall, we are committed to making healthcare technology easy and user-friendly for everyone . In this paper is not just innovative; it's also accessible and is leading the way in improving healthcare delivery for everyone.

II.EXISTING SYSTEM

In the current healthcare system, the absence of ward boys and their failure to adhere to duty schedules can have severe consequences. This situation often leads to delays in providing essential care to patients, which can be life-threatening in emergencies. Patients Fig 3.1 shows it may experience significant delays in receiving necessary treatments, leading to a worsening of their condition and, in some cases, fatalities [7]. Moreover, the lack of proper supervision and accountability in the existing system can result in the loss or misplacement of patient belongings, adding to the challenges faced by patients and healthcare providers. These issues highlight the urgent need for a more efficient and reliable healthcare navigation system to ensure timely and effective patient care.

PROPOSED SYSTEM

The proposed system aims to revolutionize healthcare navigation by leveraging Virtual Reality (VR) technology and QR code integration [8]. Traditional hospital navigation systems often fail to adequately address critical health emergencies, such as locating blood banks and emergency wards, leading to delays in treatment and patient distress. To overcome these challenges, In this paper introduces an advanced approach that combines VR technology and QR code integration [9].

By immersing users in a virtual hospital environment, our system provides seamless access to vital information via QR codes [10]. This approach bridges the gap between healthcare seekers and life-saving facilities, ultimately improving healthcare accessibility and reducing critical healthcare delays. Users can easily navigate the hospital layout, receive real-time directions, and locate vital areas such as the blood bank, emergency ward, ICU, and general ward using their mobile devices. Fig 4.1 shows that the integration of cutting-edge AR/VR technology transforms mobile devices into personal hospital GPS navigators, enhancing the overall patient experience and reducing the risk of delays during medical emergencies [11].

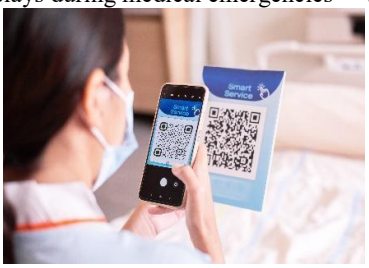

Fig.1 QR code Fixing

The proposed system represents a significant advancement in healthcare navigation, offering an intuitive solution that addresses the limitations of existing systems. By leveraging VR technology and QR code integration, aims to revolutionize healthcare navigation, making it more accessible and efficient for patients and healthcare providers.

CONCEPT OF PATHFINDING

Pathfinding algorithms are fundamental in efficiently navigating complex environments, such as hospitals. These algorithms determine the optimal route from a starting point to a destination, minimizing costs like time

and distance while avoiding obstacles. In the context of hospital navigation, pathfinding is essential for guiding users to critical areas like emergency wards, blood banks, and ICUs. [12] Algorithms like Breadth-First Search (BFS) and Depth-First Search (DFS) are key components of our navigation system. BFS systematically explores all neighbouring nodes at the current depth before moving to the next level, making it ideal for finding the shortest path. Conversely, DFS explores as far as possible along each branch before backtracking, which can be beneficial in scenarios prioritizing depth over breadth.

A.BFS

Breadth-First Search (BFS) is a fundamental pathfinding algorithm that we are incorporating into our Virtual Healthcare Navigator project to enhance hospital navigation. Developed by Edward F. Moore in 1959, BFS explores the hospital environment in a systematic manner, ensuring that every reachable area is visited in a breadth ward motion. This algorithm starts from a chosen node, such as the user's current location, and examines its neighbours first, marking them as visited. One of the key advantages of BFS is that it guarantees the shortest path from the starting point to any other reachable node in the graph. This property is particularly useful in hospital navigation, where timely access to critical areas can be a matter of life and death. Additionally, BFS uses a queue (FIFO) data structure, making it easy to implement and efficient in terms of time complexity.

B.DFS

Depth-First Search (DFS) is a vital algorithm, initially proposed as a graph traversal algorithm, explores the hospital environment in a deathwards motion, thoroughly searching each branch before backtracking. This algorithm starts from a selected node, such as the user's current location, and explores as far as possible along each branch before backtracking. One of the key advantages of DFS is its ability to efficiently traverse through large and complex environments, making it ideal for real-time navigation systems. Additionally, DFS is versatile and can be implemented using both iterative and recursive approaches, allowing for flexibility in implementation.

C. Dijkstra Algorithm

The algorithm's development was spurred by the need to address the complex nature of hospital layouts and the diverse requirements of users, including patients, visitors, and medical staff. Hospital environments can be intricate, with numerous departments, wards, and facilities spread across large areas. Navigating these spaces can be challenging, particularly for individuals unfamiliar with the hospital's layout or those in urgent need of medical attention Initially proposed by Edsger W. Dijkstra, this algorithm traverses the hospital layout by exploring one vertex at a time, starting from the origin and analysing the nearest unvisited vertex. This process is repeated until either the destination is reached or all vertices have been checked. The algorithm prioritizes the closest nodes, ensuring that the path taken is the most efficient in terms of distance and time.

D. Greedy Best First Search Algorithm

The Greedy Best First Search Algorithm is a significant to, designed to enhance hospital navigation efficiency for users. This algorithm is instrumental in determining the most promising path towards a destination, based on heuristic evaluations. Its development was driven by the need to provide users with a navigation system that can quickly adapt to changing circumstances and user requirements within the hospital environment. The Greedy Best First Search Algorithm is characterized by its ability to prioritize paths that appear to be the most appealing at each step, based on heuristic estimates of proximity to the destination.

E. A(A-STAR) Algorithm*

The A* algorithm stands out as a leading pathfinding method, renowned for its efficiency and effectiveness. By incorporating both the actual cost from the starting point and an estimated cost to the endpoint, A* consistently identifies the optimal path to the destination node within a network. This algorithm systematically explores potential pathways from the initial node, evaluating neighbouring nodes until reaching the designated destination. [13] A* leverages the "f" value, calculated as the sum of the distance from the start node to node n (g(n)) and the estimated cost from node n to the goal node (h(n)), ensuring a balanced exploration of the graph.

$f(n) = h(n)+g(n)$

Pseudo Code:

1. Add the very first node to the OPEN list.
2. Check if the OPEN list is empty or not; if it is, return failure and exit.
3. If node n is the target node, return success and quit; otherwise, select the node from the OPEN list with the least value of the evaluation function (g+h).

4. Expand node n' and create all of its successors, then place n in the closed list. For each successor n', determine whether n is already in the OPEN or CLOSED list; if not, compute the evaluation function for n' and enter it into the Open list.
5. If node n is already in the OPEN or CLOSED state, it should be connected to the back pointer, which indicates the lowest g (n') value.
6. Go back to Step 2

IMPLEMENTATION

In this initiative, we have devised an implementation to enhance hospital navigation using cutting-edge technologies. Initially, we collect the hospital's blueprint to understand its layout and landmarks. This data helps us create a precise 3D model of the hospital buildings using Blender. The model incorporates standard numbering systems for easy area identification. Next, we utilize Unity to develop an interactive virtual environment based on this 3D model. This virtual environment enables users to navigate the hospital virtually, providing a realistic experience. Additionally, we implement a QR code system throughout the hospital. [14] Users can scan QR codes to access specific locations, improving navigation efficiency, especially during emergencies.

A. Data Collection

The data collection process for in this paper involves obtaining detailed blueprints and floor plans of hospital buildings, which are then used to create accurate 3D models in Blender. These models are integrated into Unity to develop an interactive VR environment [15]. QR codes are strategically placed throughout the hospital to serve as navigation markers, allowing users to scan them for information and directions. User feedback is incorporated iteratively to refine the system, ensuring it is user-friendly and effective. Additionally, data privacy measures are implemented to protect patient information.

B. Create 3D Model

For the 3D modelling of hospital buildings and the development of a standard numbering system for navigation, the methodology involves several steps. Firstly, the blueprint of the hospital is obtained to understand the layout and structure of the buildings [16]. Using Blender software, 3D models of the hospital buildings are created, ensuring accuracy and detail in the representation. The models are then integrated into Unity to develop an interactive virtual environment.

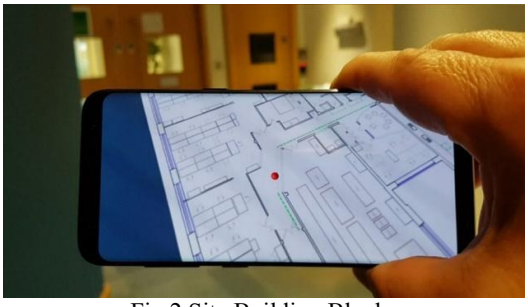

Fig.2 Site Building Blocks

During this process, Fig 6.1 refers a standard numbering system is implemented for easy identification and navigation of different areas within the hospital. This approach enables users to navigate the hospital virtually, ensuring accurate and efficient access to medical facilities [17].

C. Develop VR Module

The VR module for in this paper involves conducting a requirement analysis to understand user needs during emergencies. We select VR technology compatible with common devices like VR headsets and mobile devices. We create realistic 3D models of hospital buildings and facilities using Blender and integrate them into Unity for an interactive VR environment [18]. Fig 6.2 shows that QR codes are incorporated for users to scan and access location-specific information. Extensive user testing is conducted before deployment to improve usability, and the module is deployed in hospitals with training and support provided to users. Ongoing iteration based on feedback and emerging technologies is part of the deployment process. [19]

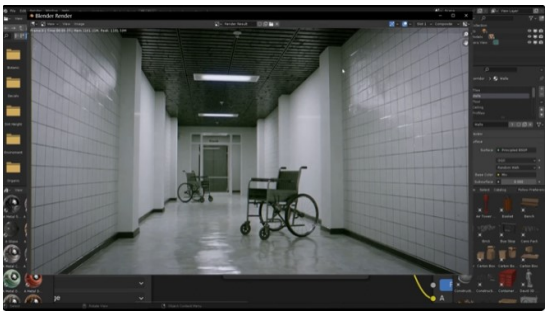

Fig.3 Unity VR Module

D. Implement QR Code Navigation

In this paper, QR code integration is a pivotal component of our hospital navigation system. We start by identifying key areas and facilities within the hospital, such as emergency rooms, blood banks, and critical care units, and assign unique QR codes to each location. Fig 6.3 indicates these QR codes contain detailed information about the respective areas, including their names, functions, and descriptions. The QR codes are strategically placed throughout the hospital for easy access by visitors [20].

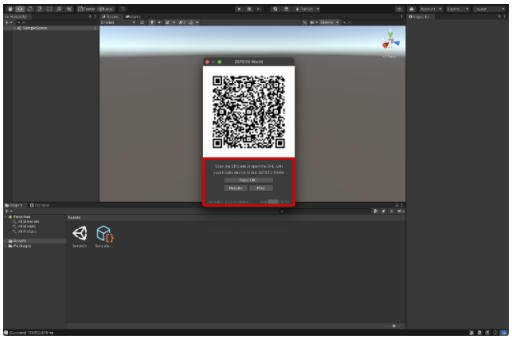

Fig.4 QR Code Integrating

Let $T_{traditional}$ be the average time taken to navigate to a critical area in the hospital using traditional methods, and T_{new} be the average time taken using our VR-based navigation system. The time saved, ΔT,can be calculated as:

$$\Delta T = T_{traditional} - T_{new}$$

Our system includes a QR code scanning feature in the mobile application, allowing users to scan the codes using their smartphones. [21] Once scanned, the application retrieves the embedded information and displays it to the user. The speed of QR code scanning, S_{QR}, can be calculated as the number of QR codes scanned per minute:

$$S_{QR} = \frac{\text{Total number of QR codes scanned}}{\text{Total time taken to scan}}$$

This information includes directions to the location, contact details, and any other relevant information. To ensure the effectiveness of the QR codes, we conduct thorough testing to verify that they are scannable from various angles and distances. We also ensure that the information retrieved is accurate and up-to-date [22].

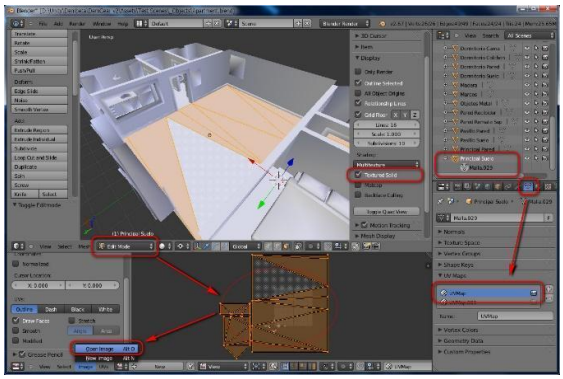

Fig.5 Gathering Requirement

Overall, Fig 6.4 shows that the integration of QR codes enhances the hospital navigation experience by providing users with quick and easy access to vital information about hospital facilities and services, ultimately improving the overall efficiency and effectiveness of healthcare delivery.

E. User Location Tracking

The methodology focuses on user location tracking, starting from the current location to the intended destination within the hospital's critical areas. The accuracy of our location tracking system can be measured using the Root Mean Square Error (RMSE) formula:

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{i-1}^{n} (x_{\text{actual}} - x_{\text{predicted}})^2}$$

Where x_{actual} is the actual location, $x_{predicted}$ is the predicted location, and n is the number of data points. The process begins with the user's current location, which is tracked in real-time using advanced location tracking technologies. [23] This information is then used to guide the user to their desired destination within the hospital, such as the emergency ward or the ICU. The methodology prioritizes accuracy and efficiency, ensuring that users can quickly and easily navigate to the required medical facilities.

I. QUANTITATIVE ANALYSIS

In our study, we employed mathematical calculations to assess the efficiency and effectiveness of our VR-driven hospital navigation system []. These computations included determining the time saved when utilizing our system compared to traditional methods, evaluating the accuracy of our location tracking system using Root Mean Square Error (RMSE), measuring the speed of QR code scanning, and quantifying the enhancement in patient experience. [24] These calculations enable us to quantify the concrete benefits of our system, such as reduced navigation time, improved accuracy in location tracking, faster information retrieval via QR codes, and heightened overall patient satisfaction. Such analyses provide an objective and robust evaluation of the efficiency and impact of our VR-based navigation system, advocating for its adoption in healthcare settings.

CONCLUSION

In conclusion, our innovative solution represents a significant advancement in healthcare accessibility and patient experience. By seamlessly integrating advanced technologies such as QR code scanning, AR/VR navigation, and a user-friendly web application, we have created a comprehensive system that streamlines hospital navigation. This transformative technology not only reduces the time it takes for individuals to access critical hospital areas but also overcomes language barriers through Multilanguage support. The strategic placement of QR codes ensures accurate navigation from the start to the end of the patient's journey, catering to individuals who may not be proficient with mobile devices. Furthermore, In this paper addresses the needs of the middle class and economically disadvantaged individuals, providing them with the best solution for accessing medical care from government hospitals. This not only reduces treatment delays but also saves costs associated with seeking care at private hospitals. Our commitment to user-centric design and continual improvement is evident throughout the system. We have prioritized ease of use, ensuring that individuals of all technical backgrounds can navigate the system confidently. Our training and awareness initiatives have equipped hospital staff and visitors with the knowledge and skills to make the most of this technology. Continuous improvement remains a core principle, and we diligently collect and analyse user feedback to refine and enhance the system continually. We are confident that this commitment to excellence will further solidify the 'Virtual Healthcare Navigator' as an indispensable tool for improving healthcare accessibility and the overall patient experience. As we move forward, we envision making a profound impact on healthcare delivery, reducing treatment delays, alleviating patient suffering, and ultimately enhancing the quality of care. It serves

as a testament to the potential of technology to bridge the gap between individuals and healthcare services. In this paper is more than just a technological innovation; it is a means to make healthcare more accessible, efficient, and patient-centered, improving lives and shaping the future of healthcare delivery. In a world where timely and efficient healthcare access is more critical than ever, the 'Virtual Healthcare Navigator' embodies our commitment to harnessing technology for the betterment of society. It is our hope that this initiative will inspire further advancements in the healthcare industry and continue to create positive changes in the lives of people around the world.

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