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MapIN - Make a Path Inside

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Abstract: ***Our aim is to provide a comprehensive summary of the evolution of indoor navigation technologies. Indoor navigation is a system that is used to locate the exact locations inside a campus. To provide a technological aspect of indoor positioning systems, there are a wide range of technologies and approaches. This system does not use the GPS (Global Positioning System) and any other Internet technologies. The aim is to create an app that would show the users a navigation route in the real world via mobile device's screen. This can be beneficial to citizens in their day to day life as it allows the user to precisely navigate to a specific location in an architecture they have never been to before, such as an airport terminal, a classroom or the library in a campus, malls/retail store to navigate the customers to the items they would like to purchase etc. The created framework ought to give, progressively, valuable route data that empowers a user to settle on reasonable and convenient choices on which course to continue in an indoor space.***

Keywords: Augmented Reality (AR), Bluetooth, Global Positioning System (GPS), Ultra Wide Band (UWB), Visual Marker, WIFI Fingerprinting

I. INTRODUCTION

Coming to explicit areas in indoor conditions is a difficult undertaking. Particularly in mind boggling and huge structures, like air terminals, medical clinics, or other public structures, individuals think that it's difficult to find their ideal spot. They frequently need to go through various ways to arrive at their individual objectives. Worldwide Positioning System i.e. GPS is appropriate for outside yet doesn't work dependably inside. Among these, it is important to tailor a route framework to fulfil the requirements of a seeking individual for the particular visit or task that must be satisfied. Nowadays, several indoor positioning and navigation systems and technologies have already been published [2] demonstrating a sensible following strategy in indoor conditions with a precision of a couple of meters down to a couple of centimetres in certain regions. These innovations, normally dependent on Bluetooth or other RF automations, just work at a brief distance and need an intricate foundation. Positioning and routing by means of Wi-Fi requires a thick organization of key iotas or access points, which prompts high support costs, however just gives positional precision of 1–3 m. Automations which are utilizing signal strength triangulation techniques permit us essentially to gauge an estimated position. Different innovations, for example, vision based strategies [1], give higher precision in positional following and furthermore gauge the direction of a gadget continuously. Nonetheless, there are still constraints concerning the limitation and unwavering quality after some time on the grounds that the vast majority of the vision installed frameworks depend with respect to the lighting conditions to give pining for results. Vision-based frameworks are well known nowadays. It has two subtypes, marker-based AR and marker-less-based AR[3]. Indeed marker-based, AR is more developed, yet additionally it needs more calculation and memory. AR is being used to superimpose directional signage on a real time environment which is seen through the smartphone's camera.

II. LITERATURE REVIEW

Thomas J. Gallagher[4], proposed an approach "A sector-based campus-wide indoor positioning system" The framework depends on the Wi-Fi fingerprinting strategy when utilized inside and can give clients helpful area data of the inside, in any event, while depending on a straightforward information base that rushes to assemble. A further developed situating calculation on the worker side can build the exactness by up to 15%.

R.Abhilash , P.Asha[7], proposed an approach "Indoor Navigation System" The system makes navigation simple by designing it to work in offline mode and street view makes the user to know the buildings inside the campus as it is in reality as it offers 2D and 3D navigation systems. Hao Xue, Lin Ma [3], has proposed an approach "A Fast Visual Map Building Method Using Video Stream for Visual-Based Indoor Localization" This paper presents ways of video stream and visual maps for indoor localization. Users can interact and navigate easily. It used the concept of image where GPS signals are often not available.

Dhanashree Dhawan, Megha Anpat, Clita D'Souza, Prof. R.V.Shahabade[5] as proposed "College grounds occasion route direction and refreshed occasion data ready framework" It will deal with GPS based android versatile schools putting together different occasions yet understudies/individuals not getting data about it. Ordinarily understudies are ignorant of the occasions circumventing them and can't investigate themselves, by their proposed framework clients can get to the insights about a specific occasion through an android application on his/her cell phone alongside the area of the occasion and the course to reach to that area with the assistance of GPS.

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Vidhyavani.A, StephinStanly, Ankit Kumar Pandey, Shivam Choudhury[6], proposed a methodology "Blend Of Real And Virtual World For Indoor Navigation utilizing Mobile Application" A framework for indoor route dependent on increased reality which is upheld on the android stage. The intricate situations can be found in different indoor conditions where one can't track down a certifiable article that goes about as an element for the route consequently we have presented the QR code-based element for that.
Yadav, R., Chugh, H., Jain, V., and Banerjee, P[3], proposed a methodology "Framework Using Visual Positioning System with Augmented Reality" The exactness of the AR tool compartment in distinguishing a marker relies upon lighting conditions. It is needed to keep up with similar lighting conditions for the marker to furnish clients with the exact route with the assistance of the marker. Later on, there can be different adjustments made to the route framework, for example, utilizing a sound module for aiding in exploring, and furthermore, the handling and alignment of the camera can be improved. AR tool boxes can be prepared in identifying hued markers as well.

III. INFERENCES DRAWN FROM LITERATURE REVIEW

Among the diverse routing procedures studied, Wi-Fi fingerprinting, RFID, and so on have an exterior equipment(hardware) necessity, for example, Wi-Fi iotas or reference points. Vision-based routing navigation and VPS, contrarily, can be accomplished without these external equipment assets, however, utilizing them together will increase the efficiency of computer vision. The different Augmented reality types and execution approaches show the different potential executions of this innovation. AR can be executed with head-mounted screens just as handheld gadgets like cell phones. Marker-based AR is the least demanding to execute however it restricts the experience only to the regions where markers are accessible. To make the user cooperation more mesmeric, we can best attempt to carry out markerless AR which is harder to execute than marker-based yet more adaptable as needed for the routing/navigation.

IV. BASIC REQUIREMENTS OF SYSTEM

A. Databases

1) Central Database Server: To store access point SSID and geo-location central database server will be used for it. When a system-specific unique SSID will be selected then it will be assigned to an access point and further using the public web API it will be crowdsourced to the database.

2) Local Application database: This will actually contain a database for specific buildings and we can call it a subset of the central database. Using the web API this database will be synchronized with the central database.

B. Web Service

To transact the data between a database and our web application the system will contain a web service. A RESTful public web API can be used to receive and respond to the user with valid arguments.

C. Indoor Mapping

Creating indoor guides of structures/buildings (universities, airports, shopping centers, and so on) isn't just about as straightforward as guides of the open-air environment. As we don't have GPS signal strength inside and it can be confusing to locate the path indoors. Additionally, such structures usually have multiple levels or floors, so essentially an optimal arrangement would require 3D guides or potential models. It is said that there are not many indoor positioning drives that are working with the test in business just as open spaces.

D. Indoor Positioning

Like a GPS for indoor environments, IPS refers to the technology that helps locate people and objects indoors. For instance, IPS technologies enable a number of location-based indoor positioning solutions, including wayfinding, inventory management, real-time location systems (RTLS) and first responder location systems. The indoor positioning solutions based on the common consumer standards Wi-Fi or Bluetooth Low Energy (BLE), but also solutions based on Ultra-wideband (UWB) or passive RFID Like a GPS for indoor conditions, IPS alludes to the innovation that finds individuals and articles inside. For example, IPS advancements empower various area-based indoor following arrangements, including constant area frameworks (RTLS), wayfinding, stock administration, and specialist on-call area frameworks. The indoor situating arrangements dependent on the normal shopper principles Wi-Fi or Bluetooth Low Energy (BLE), yet in addition arrangements dependent on Ultra-wideband (UWB) or latent RFID

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E. Navigating Algorithm

The calculations have been separated into indoor situating and briefest way calculations utilizing various advancements. It may very well be seen that the majority of the past examinations have zeroed in on indoor positioning calculations while few researchers have investigated the shortest path calculations. As delineated in Fig 1.

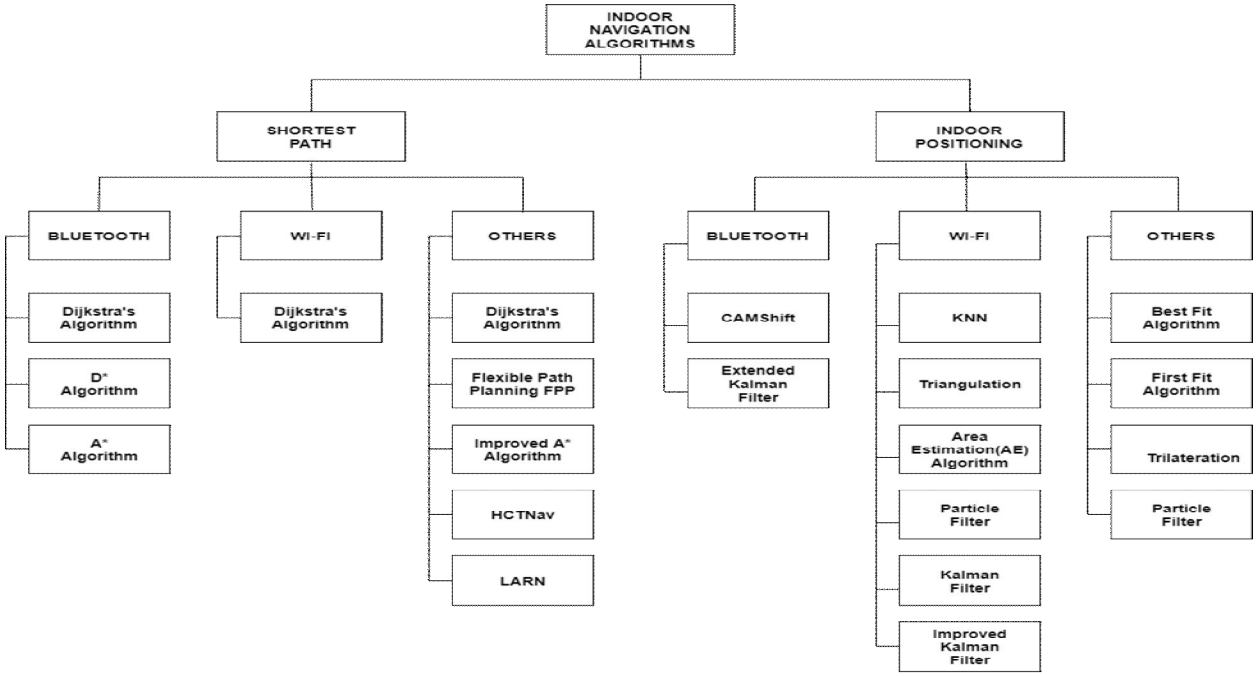


Fig.1: Indoor Navigation Algorithms for Shortest Path and Indoor Positioning

V. TAXONOMY OF INDOOR NAVIGATION SYSTEM

Having an indoor map is not enough to get the correct path inside a building since GPS signals are not available there. There has been some technology and techniques used for the indoor navigation system.

A. Proximity-based Systems

This technique uses the tag and beacons as the main component to determine the location of the person. Beacons are attached to the hardware and transfer the unique code data to a nearby hard-wired receiver. It is preferable for small areas. In Figure 2, We described the connectivity between client and the component of the system.

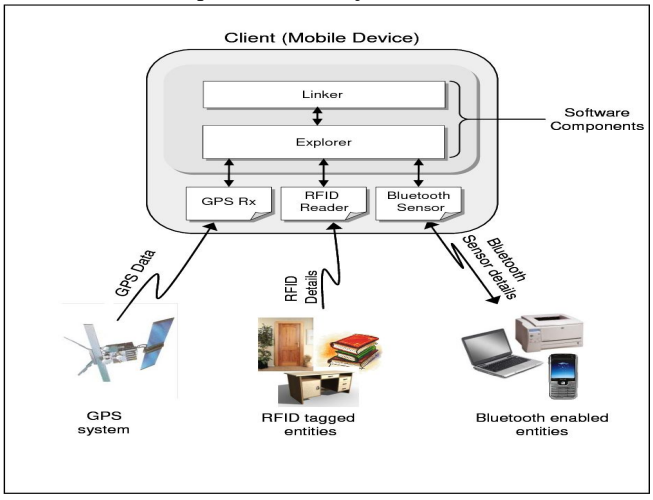


Fig 2: Proximity Architecture [8]

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B. WiFi-based Systems

Wifi Based Positioning System is also an option to get the position of the mobile device inside a building. Here we measured the intensity of wifi signals and the access points present in the database. But using this technology required a proper installation of wifi routers inside the buildings

Wi-Fi environment and reports the list of Wi-Fi access points and their associated signal strengths. The database from the survey is then used to estimate the tag's likely position. The accuracy depends on the number of nearby access points whose positions have been entered into the database. Wi-Fi climate and reports the rundown of Wi-Fi passageways and their related sign qualities. The information base from the study is then used to gauge the label's probable position. The exactness relies upon the quantity of close-by passages whose positions have been gone into the data set.

1) *Access Points:* Access points refers to the location or position where we place the networking device to connect with a wifi enabled device to the wired component.
2) *WiFi Marker:* We are placing routers in rooms to cover the whole place for RSS to be measured. Rooms are divided into smaller areas represented by nodes for referencing. Small part of a room, We have N number of nodal points.
3) *Triangulation Technique:* We will receive the signal strength from each access point and use this information to calculate the distance from each access point. This access point will give the location information. It will use all the information to triangulate the Mobile Device's position.

Steps to calculate user position with the help of WiFi

a) Get the latitude and longitude
b) Position of user's smartphone with respect to each wifi.
c) Calculate the shortest distance.
d) Matched the calculated value with the stored database.

4) *Received Signal Strength Indicator:* It's used to estimate the state of a dynamic system from a series of incomplete and noisy surroundings.

$$\boldsymbol{RSSI(smooth)=\alpha*RSSI(n)+(1-\alpha)*RSSI(n\text{-}1)}$$

Now the Kalman filter is used to convert the RSS value into distance. When we received three valid estimates from Kalman's filter from any of the access points then we used this to localize the user's position.

To minimize the difference between the expected and actual location. We keep on tracking the output result of our system using EVM. **EVM** stands for Error Vector Magnitude is actually Root Mean Square (RMS) of the error vectors calculated and expressed as a percentage of the EVM Normalization Reference..

To design the Wifi based system we have four main functions. We have described those functions in Figure 4.

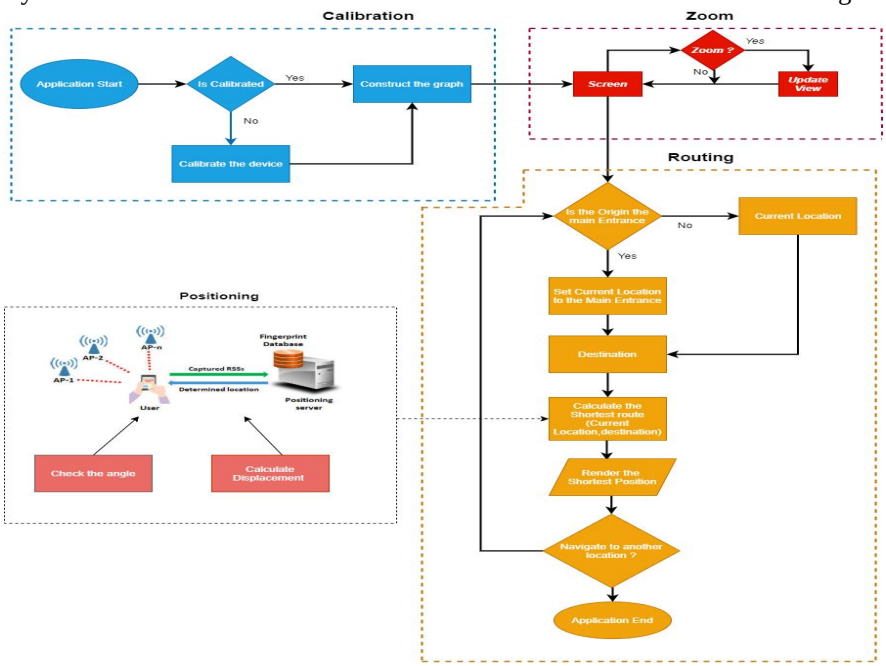


Fig 3: System flow for WiFi

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C. Ultra Wide-Band (UWB) System

Ultra Wide-Band is a wireless technology that can be used for data transmission and positioning. Unlike the other common wireless technologies like BLE or Wifi, this wide band transmits low amounts of power spread over a wide range of frequencies. Nowadays ultra-wideband chips are small enough so that they can be placed in any other device like smartphones. The frequency range of Ultra-wideband is in the range of 3.1 to 10.6 GHz. Its only drawback is its short range. Also, UWB is ideal for delivering a lot of data from the transmitter to other devices as UWB uses low power and high bandwidth. Super wideband is a remote correspondence convention that utilizes radio waves such as Wi-Fi and Bluetooth. The transmitter of the UWB sends a tremendous measure of radio heartbeats across the wide range of recurrence and further, the UWB beneficiary makes an interpretation of those heartbeats into information. As the bats use echolocation to comprehend their environmental factors, UWB heartbeats can be additionally used to comprehend the distance between two transmitters. Precise distance measurement will be inversely proportional to the duration of the impulse. UWB sends billions of pulses per second and it achieves a real-time accuracy. UWB encodes information by sending pulses in patterns. To encode a single bit of data it takes 32 to 128 pulses. In latest smart phones UWB is used and whenever they come closer to other UWB devices, they start ranging, or measuring, their exact distance. This ranging is achieved by Time of Flight the time taken by pulse to reach from one point to another.

The following two elucidations depend on augmented reality technology.

1) AR Cloud with Visual World Saving

The cloud arrangement given by Google permits adding virtual items to an AR scene. Various users would then be able to see and cooperate with these articles all the while from various situations in a common actual space. The position of the area around which the world is moored is saved to the cloud. For this situation, what is implied by "the world" is pictures that are taken from the camera view.

AR Cloud also come up with some disadvantages:

Cloud anchors can be settled for no longer than 24 hours after they are facilitated. Google is as of now creating constant Cloud Anchors, which can be settled for any longer time-frames.

This arrangement just works with a steady organization association.

The indistinguishable (not unique) surroundings can cause mistaken outcomes.

2) Visual Markers –based indoor navigation using AR

This arrangement depends on making visual markers, otherwise called AR Markers, or ARReferenceImage, and afterward recognizing their position. For this situation, all you need is your camera. Approaching information about the world around your camera field of view, you can deal with this information and apply any logic you need. That is the reason we at last chosen this technique. A visual marker is a picture perceived by Apple's ARKit, Google's ARCore, and other AR SDKs. Visual markers are utilized to advise the application where to put AR content. In the event that we place a visual marker at someplace in space, on a door or floor surface for instance, then, at that point when scanning via camera, we will not only see the marker addressed in AR but additionally solicit directions in reality.

VI. INDOOR MAPPING INITIATIVES

1) *Google Indoor Maps:* It permits you to find building architecture on Google Map, transfer and adjust the building's floor map, and submit it for refining. When processed, the indoor guide will be accessible in Google Maps.
2) *Open Street Maps (OSM):* The OSM is an open license planning and mapping resource by individuals from academia and the overall population. Here the point is to make a free editable guide of the world, in light of the idealogy of Wikipedia, for example, ordinary citizens will gather geological information utilizing a manual inspection and transfer it to the world guide.
3) *Micello:* It is one of the business items which has a decent assortment of indoor guides(maps) and furthermore gives on-request indoor guides. It has its own SDK likewise, by which one can fabricate indoor navigation based portable applications.

VII. CONCLUSIONS

The indoor navigation is unquestionably implementable with cell phones and smartphones in the current situation, and potentially with lesser issues in a couple of years. The eventual fate of AR is genuinely acceptable with the improvement in equipment, sensors, and designs.

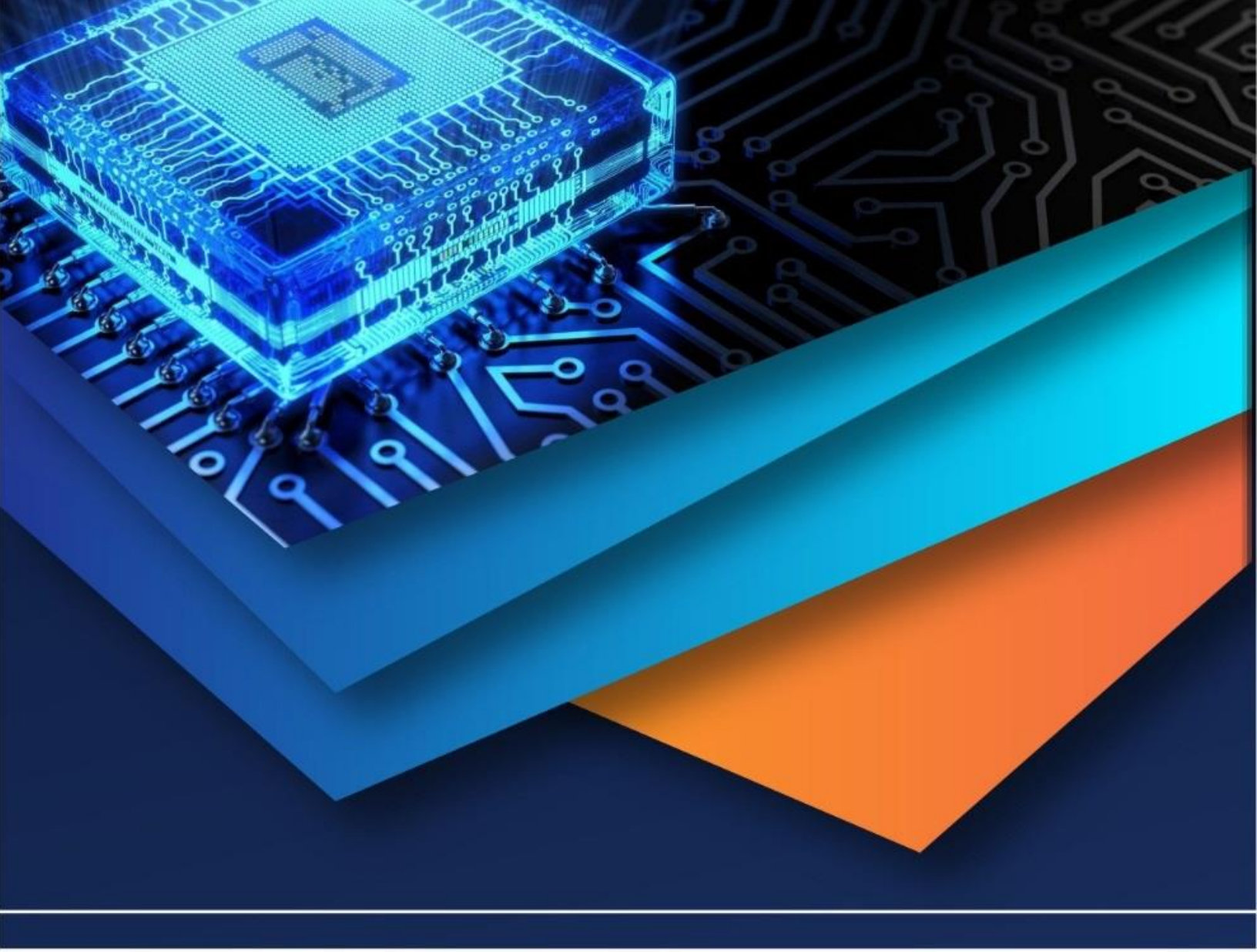
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Both indoor navigation and AR are destined to be discovered across all gadgets and applications. Utilizing this innovation, the power of cell phone cameras and computer vision can be joined with indoor guides to reconsider the navigation route. Accordingly, the possibility of the improvement of an AR interface on cell phones for indoor routes enjoys a benefit as a mobile application.

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