iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 2 **Issue:** IV **Month of publication:** April 2014

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

ISSN: 2321-9653

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

Tracking And Positioning Of Mobile Systems In Telecommunication Networks

Ritu Rani 1, Vikas Malik 2

1 (M.Tech N.S. (CSE), School of Engg. & science, BPSMV Khanpur Kalan ,India)

Under the guidance of

2 (Assistant Prof. in SES, BPSMV Sonipat)

Abstract: Mobile positioning technology has become an important area for emergency as well as for commercial services. Mobile positioning in cellular networks will provide several services such as, locating stolen mobiles, emergency calls, different billing tariffs depending on where the call is originated, and methods to predict the user movement inside a region. The evolution to location-dependent services and applications in wireless systems continues to require the development of more accurate and reliable mobile positioning technologies. The major challenge to accurate location estimation is in creating techniques that yield acceptable performance when the direct path from the transmitter to the receiver is intermittently blocked. This is the Non-Line-Of- Sight (NLOS) problem, and it is known to be a major source of error since it systematically causes mobile to appear farther away from the base station (BS) than it actually is, thereby increasing the positioning error.
In this paper, we present a simple method for mobile telephone tracking and positioning with high accuracy. Through this we will discuss some technology used for mobile positioning and tracking.

Keywords – Mobile Technology, Need for Geo location, Handset Based Mobile Positioning &Tracking, Direction based Geo-location, Location Tracking Curve method.

1. INTRODUCTION MOBILE TECHNOLOGY

In a cellular mobile telecommunication network, the whole service area is divided into a several coverage areas having respective base stations (BS). Each BS coverage area is called a "*cell*." Each BS is provided with a frequency of a range between 450 to900 MHz more than one cell can use same frequency. Only condition is that no two adjacent cells must have same frequencies. Tracking the location of a mobile subscriber within the boundary of a cell in a mobile telecommunication network is known as "*location based services "*.

Mobile technology includes mainly two functions. They are call fixing and hands-off process. All the BSs are sending a signal of power 25 to 30w to the mobile unit. When a user switches ON his mobile, it will search for the strongest signal and get connected to that BS. Then the mobile unit sends an identification signal to the BS. When he fixes a call, the BS accepts the request and sends the request to the BSC and MTSO. Then the MTSO will search where the subscriber is and connects the call. When a user moves to another cell the MTSO will change the frequency allotted to it and allots the frequency of the new BS. For both these processes GEOLOCATION of the mobile unit is essential. As shown in following Figure:-

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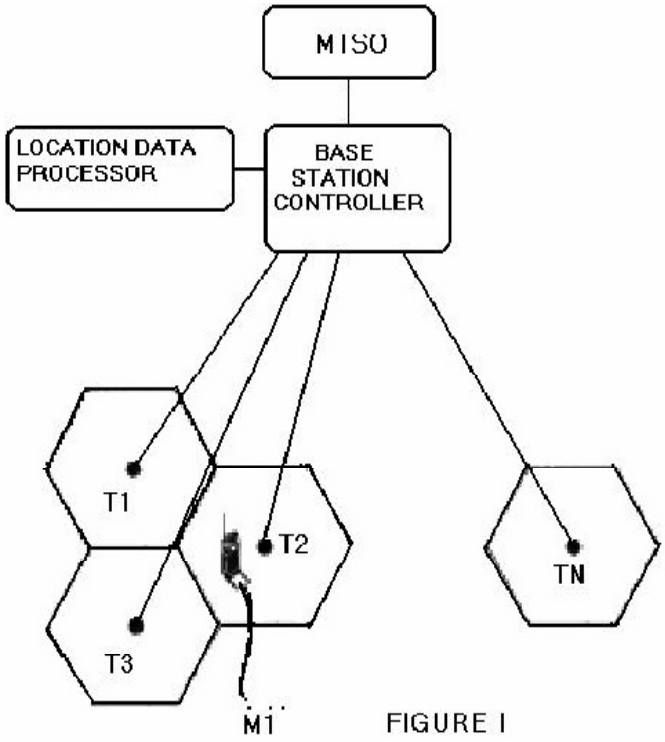


FIGURE I

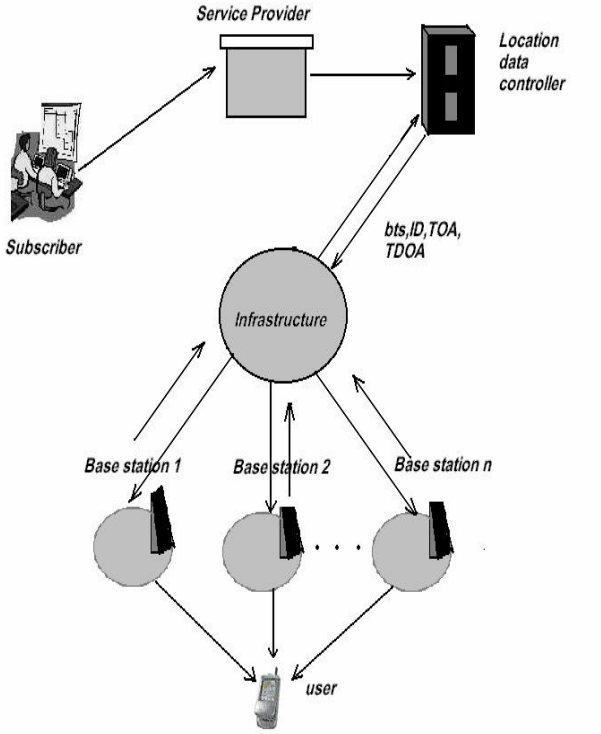
the mobile telecommunication network includes a several base stations (BSs) T 1 to T N for providing mobile telecommunication service to a mobile subscriber through a mobile telephone M1, a base station controller (BSC) for controlling the BSs T 1 to T N, and a mobile telephone switching office (MTSO) for connecting the BSC to another BTS or a PSTN (Public Switched Telephone Network).

2. NEED FOR GEO-LOCATION

One of the most powerful ways to personalize mobile services is based on location. The location based services, provides the subscribers very best of the service. Recent demands from new applications require positioning capabilities of mobile telephones or other devices. The ability to obtain the geo-location of the Mobile Telephone (MT) in the cellular system allows the network operators to facilitate new services to the mobile users. The most immediate motivation for the cellular system to provide MT position is enhanced in accident emergency services. The geo-location of the mobile user could provide services like-

. Emergency service for subscriber safety .
. Location sensitive billing .
. Cellular Fraud detection .
. Intelligent transport system services .
. Efficient and effective network performance and management .

An example of geo-location system architecture is shown in Figure. In order to fix a call the subscriber we are calling must be located accurately. A geolocation service provider provides location information and location aware services to subscribers.



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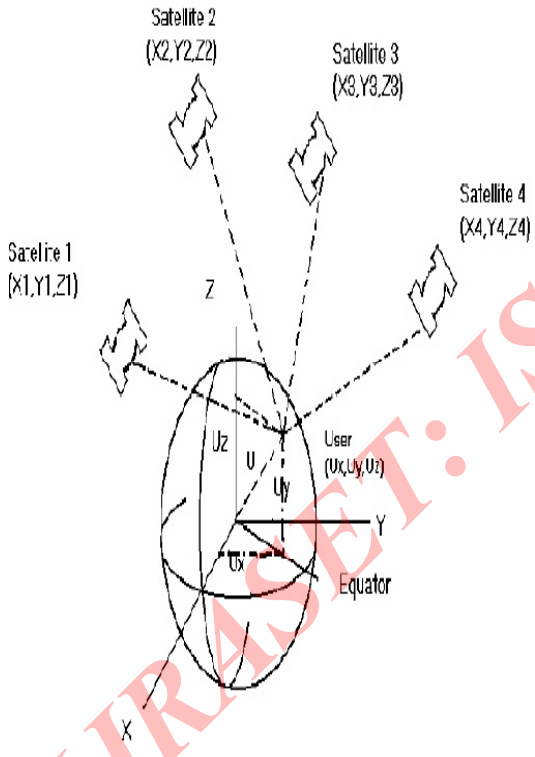
ARCHITECTURE OF A GEOLOCATION SYSTEM

3. TECHNOLOGIES USED FOR GEOLOCATION

3.1 HANDSET BASED MOBILE POSITIONING AND TRACKING

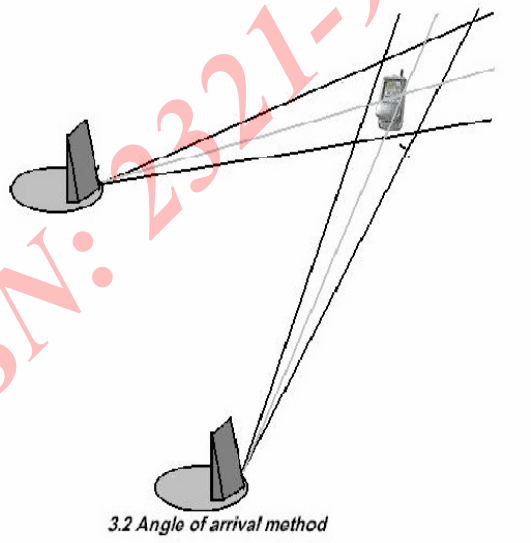
GLOBAL POSITIONING SYSTEM (GPS):- To locate the mobile telephone by itself, the mobile telephone is provided with a GPS receiver to calculate its location in latitude and longitude coordinates based on the location information received from a satellite through the GPS receiver.



3.2 DIRECTION BASED GEOLOCATION

ANGLE OF ARRIVAL METHOD:- This method calculates the angle of arrival of signal receiving at the BS. When a mobile user switches the system ON it receives the signal from different base stations, may be 3 or 4 or more. The angle of arrival method two or more base station for the determination . It measures the direction of signal falling on the base station and measures the angle of incidence with respect to a normal and determines the position of the system. Angle of arrival method is not an accurate method used for the mobile positioning because of its some disadvantages such as:

. The determination of the system will be in error if the angle of incidence is changed due to any obstacle like atmospheric particles or due to scattering etc.
. The accurate location cannot be determined if the mobile user is in between the BSs, that is in a straight line.It cannot be used for the indoor environments.



3.2 Angle of arrival method

3.3 DISTANCE BASED POSITIONING

a)TIME OF ARRIVAL (TOA)
The TOA method calculates the distance of a mobile telephone and a BS based on the TOA of a signal transmitted from the mobile telephone at the BS. It is assumed that the mobile telephone is located at the intersection point of three circles having the radius of the distances between the BSs and the mobile telephone. The distance is calculated by the following equation.

$$Ri = C\tau i = \text{sqrt}((xi - X)2 + (yi - Y)2)$$ where,

C – Propagation speed of electromagnetic wave,

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τi – propagation of time from the mobile telephone to ith base station,
xi, yi - location of ith base station,

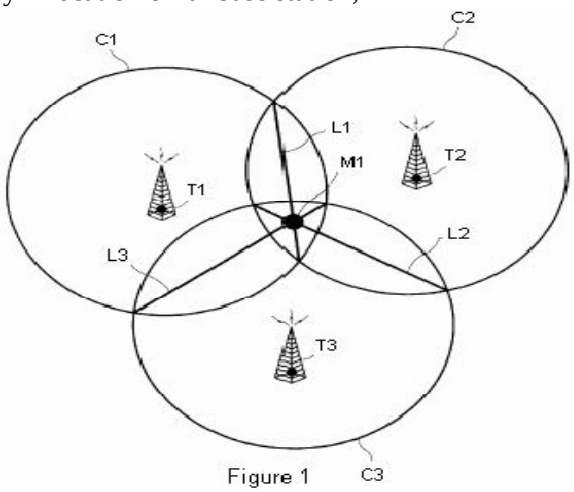


Figure 1

Figure3.3 show a typical TOA method for locating a mobile telephone.

b) TIME DIFFERENCE OF ARRIVAL (TDOA)

The TDOA method assumes that the TDOAs of a signal transmitted from the mobile telephone at the three BSs define a set of points on a hyperbola, and the mobile telephone is located at the intersection point of at least three hyperbolas. As shown in following fig.

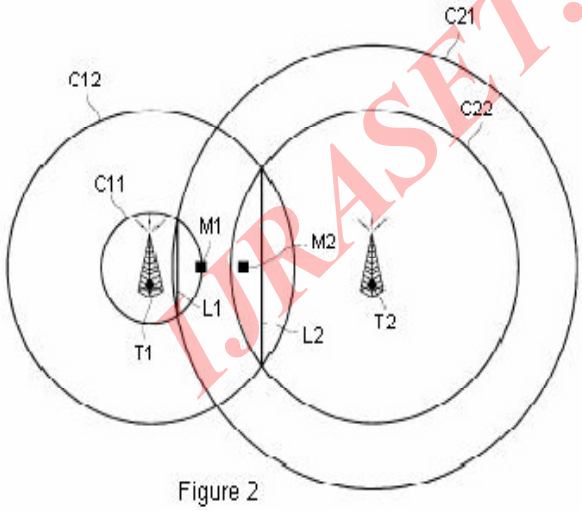
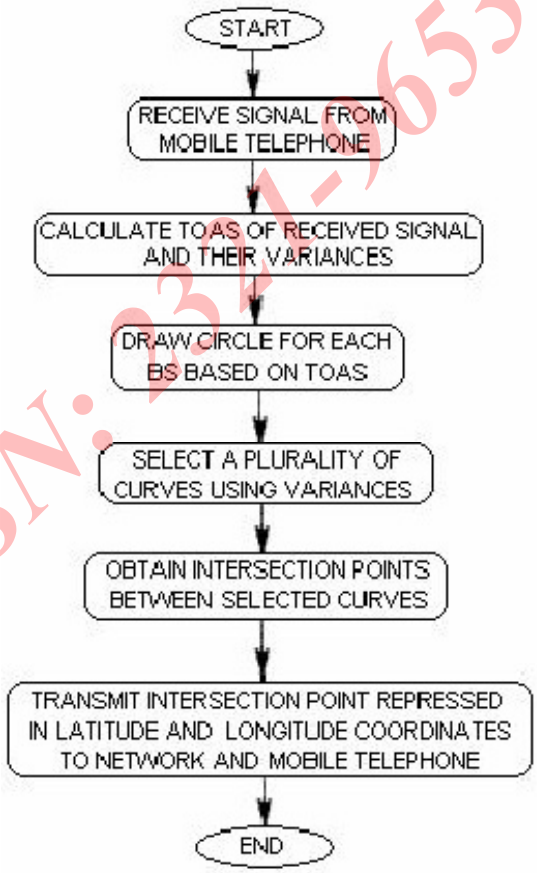


Figure 2

Figure3.4, show the TDOA method of locating a mobile telephone.

c) LOCATION TRACKING CURVE METHOD

The method proposed by us for tracking the location of a mobile telephone using curves connecting the points where circles intersect one another, the circles radii being the distances between BSs and the mobile telephone. The steps involved are:-



Flowchart showing the steps involved in locating a mobile telephone

4. SOME NEW TECHNIC IN MOBILE TRACKING AND LOCATING METHOD

a)Cell Phone–Based System Could Improve HIV/AIDS Drug Tracking The NYU researchers aim to make a project they call Smart Track—a low-cost, cell phone–based system that will make it easier to gather important patient data and to track the

ISSN: 2321-9653

flow and consumption of drugs in HAART (Highly active antiretroviral therapy) programs.

In following fig. shows A health worker in Ghana extracts blood to measure the T-cell count of a patient. Smart Track enables medical professionals and even patients themselves to remotely access and update a patient's T-cell history on a mobile phone using a single SMS message.

To track the drugs, they plan to use "smart tag" technology—such as bar codes or radio-frequency identification (RFID). Smart tags will be attached to packaging—from bulk containers to individual pill bottles. As the drugs move through the supply chain, healthcare workers, physicians and patients will be able to use Smart Track phones to scan the tags and confirm each shipment's progress.
Smart Track phones will also be equipped with a data gathering application that will enable physicians and healthcare workers to keep tabs on an individual patient's adherence to HAART regimens and to monitor how the patient is responding to treatment.

b) Control plane locating A control plane locating the service provider gets the location based on the radio signal delay of the closest cell-phone towers (for phones without GPS features) which can be quite slow as it uses the 'voice control' channel. In the UK, networks do not use trilateration, LBS services use a single base station, with a "radius" of inaccuracy, to determine a phone's location. This technique was the basis of the E-911 mandate and is still used to locate cellphones as a safety measure.

In order to provide a successful LBS technology the following factors must be met:

.Coordinates accuracy requirements that are determined by the relevant service;
.Lowest possible cost;
.Minimal impact on network and equipment .

c) GSM localization GSM localization is the second option. Finding the location of a mobile device in relation to its cell site is another way to find out the location of an object or a person. It relies on various means of multilateration of the signal from cell sites serving a mobile phone. The geographical position of the device is found out through various techniques like time difference of arrival (TDOA) or Enhanced Observed Time Difference (E-OTD).

d) Self-reported positioning A low cost alternative to using location technology to track the player , is to not track at all. This has been referred to as "self-reported positioning". It was used in the mixed reality game called Uncle Roy All around You in 2003 and
considered for use in the Augmented reality games in 2006.Instead of tracking technologies, players were given a map which they could pan around and subsequently mark their location upon. With the rise of location based social network, this is more commonly known as a user "check-in".

e) Mobile eye tracking This device is agnostic, allowing users to use the exact handset or device they would normally carry out the task on, or even use their own if necessary.

5. CONCLUSION

Our proposal is advantageous in that the location of a mobile telephone can be accurately tracked even in the multi path fading and the NLOS environment, by using more accurate tracking curves connecting the intersection points among circles with the radii being the distances between corresponding BSs and the mobile telephone in a cellular mobile communications system. We have described about accurate positioning of mobile telephones, which can be used for several applications. The important considerations to be undertaken while selecting a location based technology are location accuracy, implementation cost, reliability, increasing functionality.

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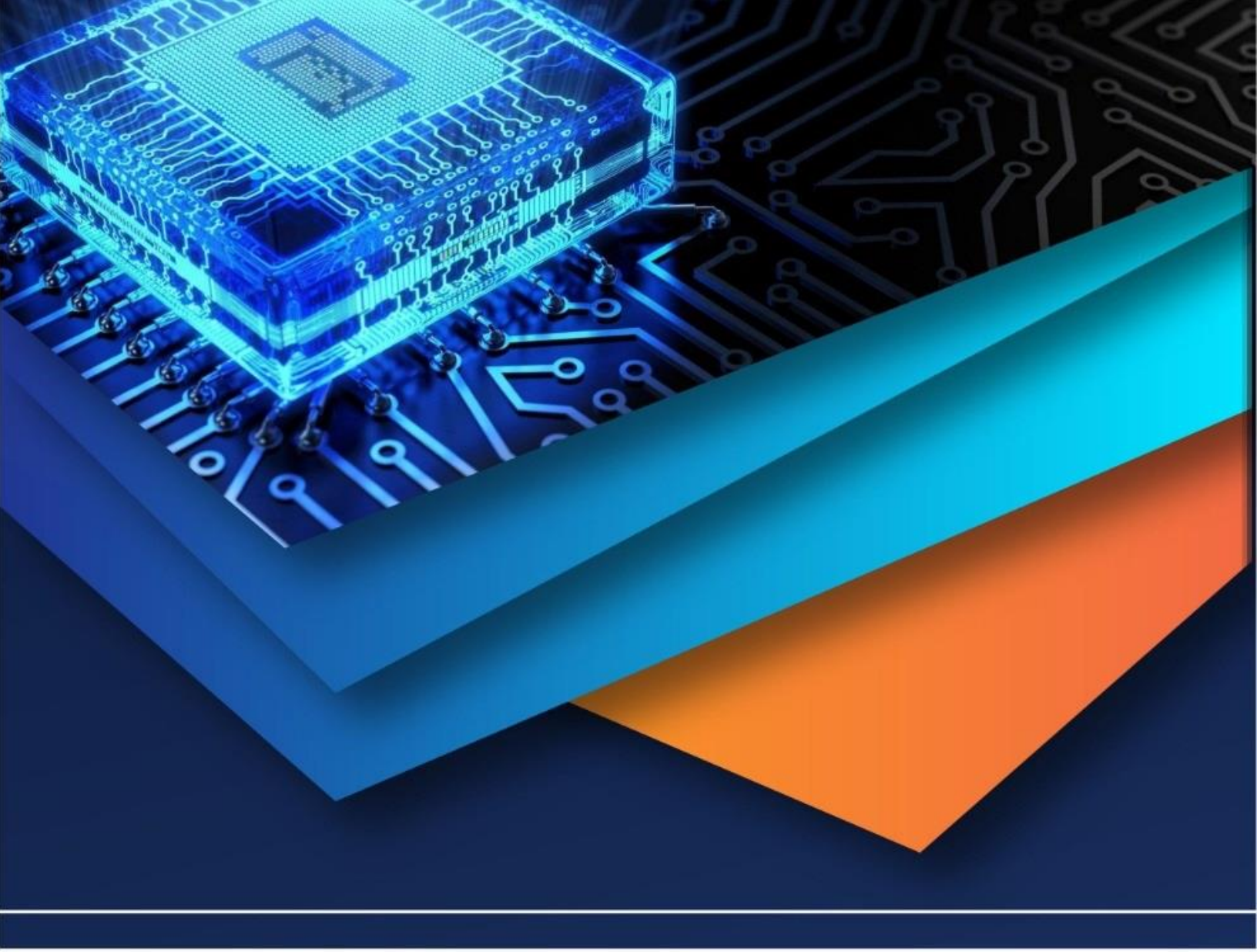

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