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AirCompass: An Air Quality Monitoring and Alerting Application

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Abstract: ***Air pollution, which was a global problem to begin with, is an even bigger cause affecting public well-being and health now. We present AirCompass, a clean air alert and monitoring application, to cater to the need for proactive protection and real-time monitoring. AirCompass obtains the current Air Quality Index (AQI) values from two sound sources, IQAir and WAQI APIs. AirCompass uses the IQAir and WAQI APIs, two reliable sources, to retrieve current Air Quality Index (AQI) data. Moreover, it alerts users in real-time when they are nearing areas with visibly high pollution levels. The app instructs users to take precautionary measures immediately to reduce health hazards along with alerting them to the air quality in the area. A discussion forum for the community, informative blog entries, a section on preventive health practices, and a feature to lead users through areas with improved AQI levels are some of the other features provided by AirCompass. With the integration of precise data gathering, perceptive alerting capabilities, and user interaction features, AirCompass enables individuals to make more secure and healthier choices where there is contamination. The paper explains the architecture, most notable features, implementation issues, and expected impact of the application on raising public awareness of environmental health concerns.***
Keywords: ***Air quality monitoring, AQI, mobile health app, environmental sensing, real-time pollution alerts, IQAir API, WAQI API, geolocation, public health, mobile application development, air pollution awareness, personalized notifications, health-based routing.***

I. INTRODUCTION

One of the most important environmental health issues of the day is air pollution, which significantly influences the quality of life and public health. Air pollution, according to World Health Organization (2025), refers to the presence of one or more pollutants in the air at concentrations and durations that are injurious to human health. It is a causative factor for many acute and chronic diseases, such as respiratory diseases, cardiovascular disease, stroke, and even neurodegenerative diseases. Air pollution is estimated to be responsible for 667 million deaths worldwide annually, emphasizing the need for effective awareness campaigns and preventive strategies (Sagheer et al, 2024). The effect of air pollution goes beyond physical health. Furthermore, mental health, motivation, and even intellectual capacity are influenced by the quality of air we breathe (Şahin &Işıkdağ, 2017). It is essential to equip people with the tools they need to make an informed decision about their environment since over 90% of all individuals live in areas where air quality surpasses WHO standards (World Health Organization, 2023; Sokhi et al., 2022). As per studies, when individuals react to real-time pollution alerts by modifying their behaviour, for example, by not exercising outdoors or altering their route to work during high pollution times, public health gains can be achieved (Kelly et al., 2012).

Despite being of paramount concern, public awareness of current air quality is usually low. This disconnection between environmental risk and public response is most dangerous in urban areas, where pollution events can develop rapidly and disproportionately affect susceptible groups. According to the World Health Organization, air pollution is a problem globally across all income levels, and it needs more public access to environmental data and actionable health data (WHO, 2023). In response, recent studies have pointed out the role of digital technologies—above all, mobile and IoT-based systems—in delivering timely pollution warnings and educating people in appropriate behaviours (Kelly et al., 2012; Bible, 2024).

Motivated by these challenges and the increasing interest in conveniently accessible, current air quality information, we present AirCompass, a mobile application that ties environmental data to personal health action. AirCompass users receive smart notifications from AirCompass when levels of pollution in their surrounding environment are hazardous. AirCompass downloads recent Air Quality Index (AQI) data from respected sources, like the IQAir and WAQI APIs. In addition to serving as a system of alarms, AirCompass also maps users on less polluted paths, offers education materials, and shares community interaction by way of discussion boards and preventative care materials.

AirCompass is seeking to heighten awareness of individuals when it comes to air pollution issues and allow persons to protect themselves against contaminated environments by using solid data, simplicity, and effective information.

II. LITERATURE SURVEY

Air pollution has been firmly established as a critical threat to public health. According to the World Health Organization (2023), ambient air pollution contributed to an estimated 4.2 million premature deaths globally in 2019. Numerous studies link long-term exposure to air pollutants—particularly fine particulate matter (PM2.5 and PM10)—to increased risks of stroke, ischemic heart disease, chronic obstructive pulmonary disease (COPD), and lung cancer (World Health Organization, 2025). These findings are reinforced by Sagheer et al. (2024), who identify air pollution as the leading environmental risk factor for cardiovascular disease, emphasizing that short- and long-term exposures significantly elevate morbidity and mortality.

Beyond chronic illnesses, real-time pollution spikes, or Severe Air Pollution Episodes (SAPE), are known to cause sudden surges in respiratory distress and hospital admissions. Pickford et al. (2019) highlight the need for timely public alerts during such episodes, especially for vulnerable populations such as children, the elderly, and individuals with pre-existing respiratory conditions.

To address these public health challenges, various technologies have been developed to track and report air quality in real-time. The Air Quality Index (AQI), which reflects concentrations of pollutants such as PM2.5, PM10, NO_2, CO, and SO_2, provides a standardized method for assessing and communicating air pollution levels (Şahin &Işıkdağ, 2017). The relevance of AQI-based health alerts is further supported by Sokhi et al. (2022), who identify PM2.5 and PM10 as among the most hazardous pollutants, capable of penetrating deep into the lungs and bloodstream.

Mobile applications have increasingly been used to deliver environmental risk information to the public. Kelly et al. (2012) point out that early warning systems integrated with air quality modelling can enable individuals to modify their behaviour, such as avoiding outdoor activity or altering routes, during high pollution periods. Similarly, Bible (2024) discusses the EASIER platform, which combines real-time air monitoring, user alerts, and educational content to increase health literacy and risk awareness.

These studies collectively underscore the need for a comprehensive, user-centric solution that not only monitors air quality in real-time but also translates data into actionable guidance. AirCompass builds upon this foundation by integrating trusted AQI data sources, personalized alerts, route optimization, and community engagement tools—bridging the gap between environmental sensing and everyday decision-making.

III. METHODOLOGY

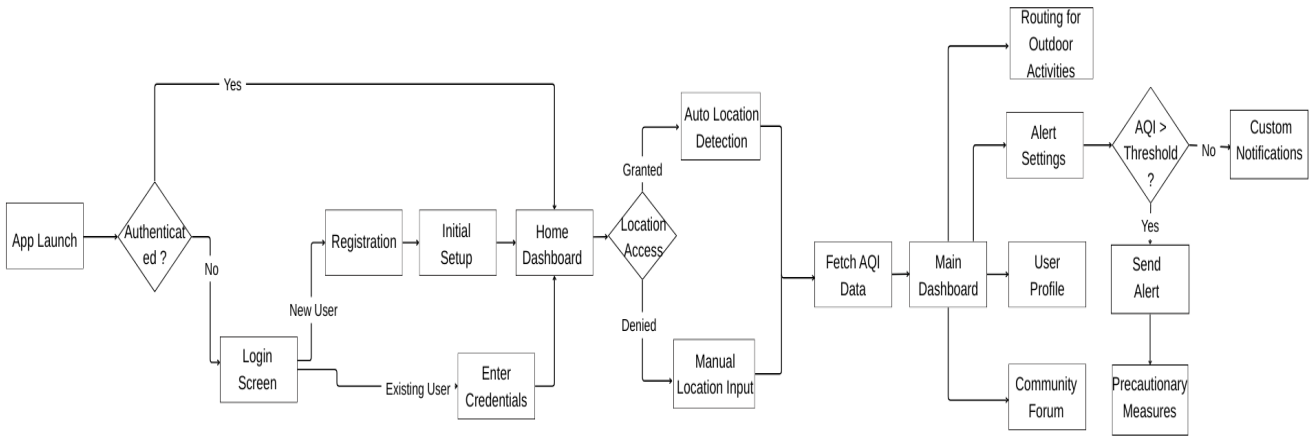


Fig. 1AirCompass Application Workflow and System Architecture.

A. Design and Development Strategy:

AirCompass development was built on a user-focused, modular design philosophy to address the growing need for real-time, personalized air quality monitoring. The app is built using React Native and the Expo framework to facilitate seamless deployment to mobile platforms. TypeScript was employed to provide robust, maintainable code from the outset of development.

Design priorities went beyond performance requirements such as data accuracy and warning response time to include user usability, customization, and responsiveness to health. Mobile systems have been very promising in the provision of timely and geospatial air quality notifications (Kelly et al., 2012; Bible, 2024).

B. Data Integration and AQI Evaluation:

AirCompass integrates two reliable air quality data feeds: the IQAir API and World Air Quality Index (WAQI) API. Both APIs provide near real-time pollutant levels, including PM2.5, PM10, NO_2, O_3, SO_2, and CO.

The application uses this data client-side as RESTful GET requests (Şahin &Işıkdağ, 2017), yielding fast response and minimal server dependency. Such a design is backed by empirical evidence that air pollutants change quickly in terms of time and space, requiring real-time and location-based monitoring (World Health Organization, 2023). The app cross-checks real-time data with user-set thresholds and global standards laid by the WHO, facilitating immediate and context-specific-alerts (Sokhi et al., 2022).

C. Intelligent Alert System:

Smart alert system is the core innovation of AirCompass. As opposed to fixed monitoring apps, AirCompass repeatedly cross-matches received AQI data with personalized user thresholds to determine whether to send health-critical alerts. The system includes:

- Smart Alerts: Generic alerts if AQI goes beyond a user's preferred level.
- Health-Based Alerts: Tailored to individuals with specific health vulnerability, i.e., asthma or heart condition.
- Daily Summaries: Timed reminders offering daily air quality trends for the user's location.
- Precautionary Advice: Site-specific advice like wearing a mask or staying outdoors to the barest minimum between high-risk periods.

This alert mechanism is delivered over Expo's push notification service such that the app can send warnings to the user even when running in the background or closed state. There is a "Quiet Hours" feature that silences alerts within defined time periods. Such real-time dynamic alerting has been shown to be effective in minimizing public exposure in circumstances of high-risk pollution incidents (Pickford et al., 2019; Kelly et al., 2012). The system is also based on large-scale platforms such as EASIER and AWAIR that use customizable thresholds and push notifications to provide health-relevant-information (Bible, 2024).

D. Location Services and AQI-Based Routing:

AirCompass uses the device's geolocation (via Expo Location) to identify the location of the user and fetch hyper-local AQI data.Since toxins such as PM2.5 and PM10 change notably within a close proximity (World Health Organization, 2023), this localizing improves accuracy for warnings. Routing extends the service by casting the eye over conceivable routes and advising cleaner diversions, in the style duplicating the strategy of systems like airTEXT and the London Air App (Kelly et al., 2012).

E. User Experience and Interface:

The application has a readable interface with color-coded AQI bands that are easy to read, allowing users to easily understand air quality status at a glance. Users can from the home dashboard set their alert preferences, see summaries,
plan routes, and access the community forum.Since mobile phones are at the heart of environmental sensing and behavior adaptation (Kelly et al., 2012), UI/UX was well thought out such that it balanced information richness and accessibility.

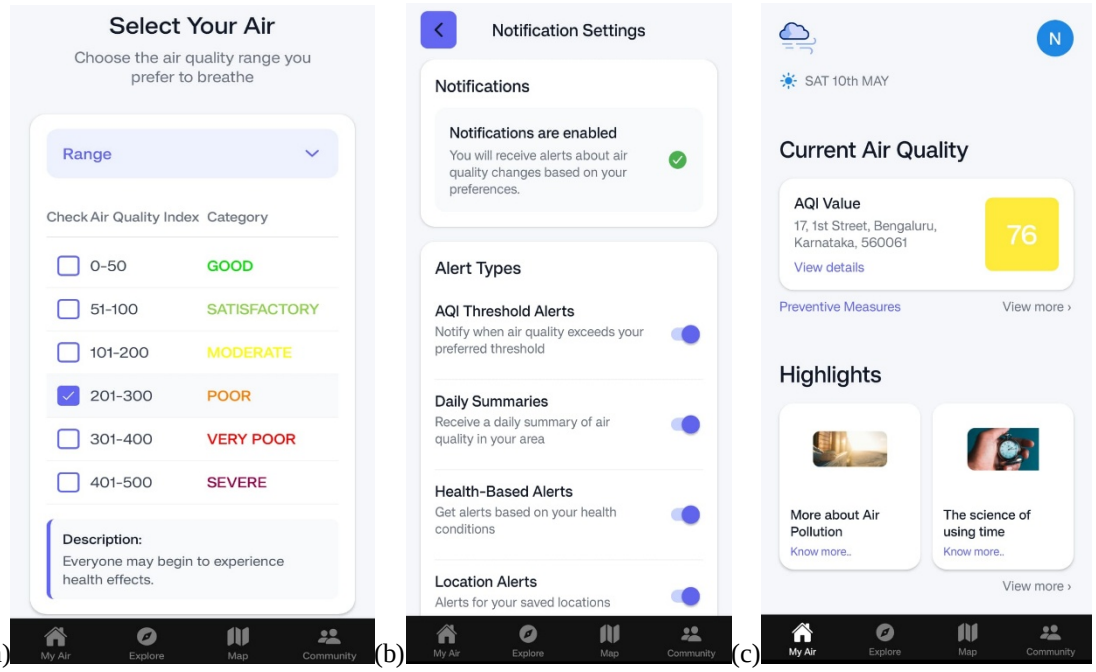
F. Community and Educational Engagement:

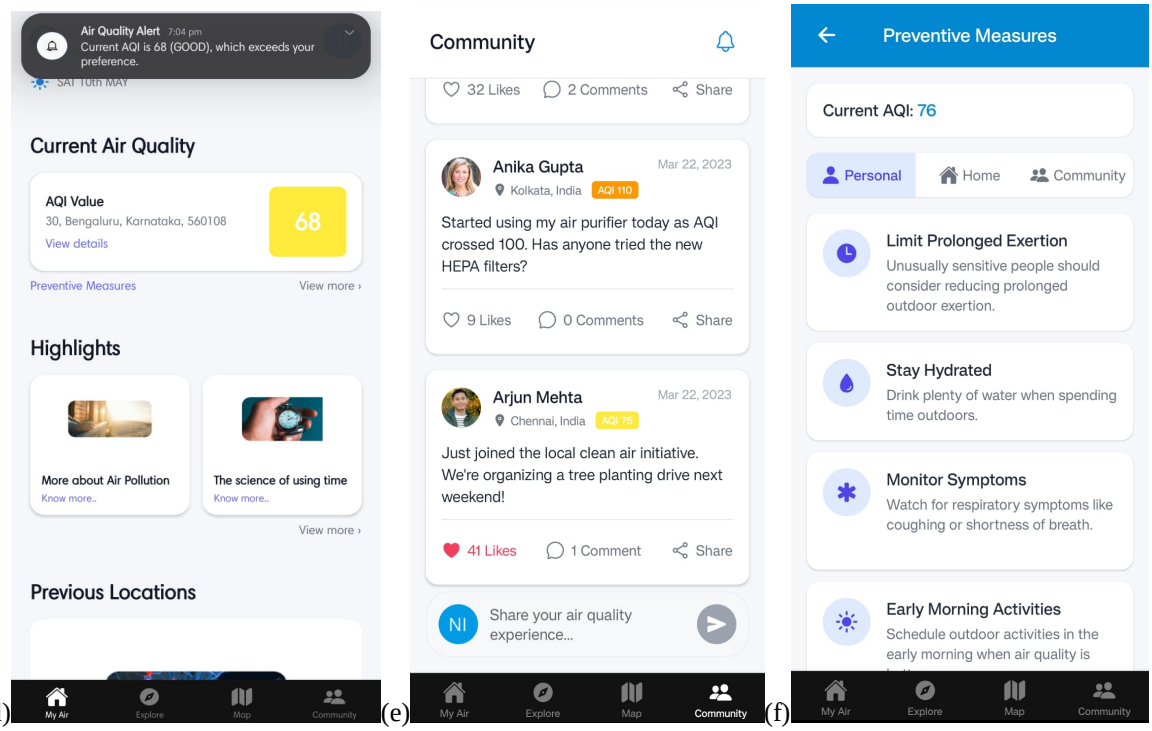
In addition to the personal monitoring, AirCompass involves users and raises people's awareness of the environment through two central features:

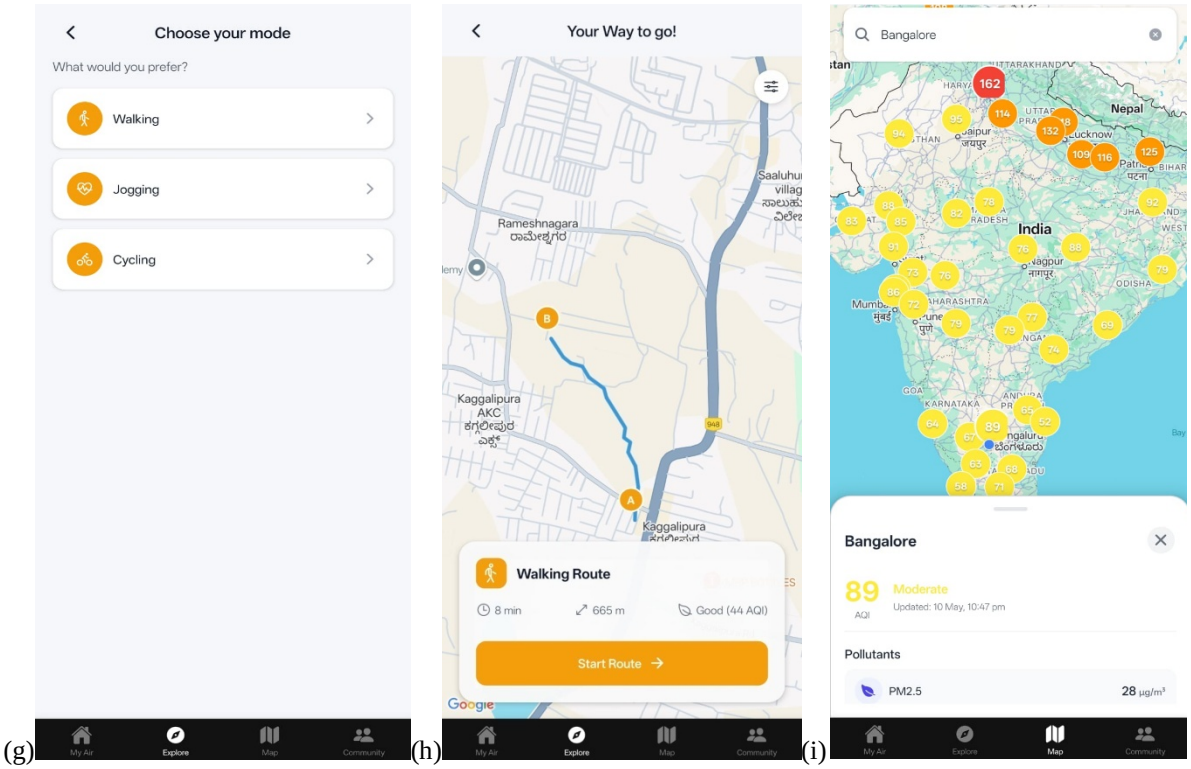
- A blog page that displays selected articles about air pollution, health impacts, and adaptation methods. An on-line discussion board through which local residents exchange information about their communities, ask questions, and provide each other with mutual assistance and comment on air quality levels.
- This method is in accord with the pedagogical objectives of platforms like EASIER, where data in real-time is supplemented with sensitization campaigns (Bible, 2024).

G. Data Privacy and Ethics:

User privacy and proper use of data are core to AirCompass. The app never collects or saves individual health information, other than overall preferences to tailor alerts. Only with user authorization is location accessed, and a manual input of location is provided. User options are securely saved through Supabase, with all interaction adhering to guidelines of privacy to establish trust and openness.







(g) (h) (i)

Fig. 2User Interface Screens of the AirCompass Mobile Application
(a) AQI Range Selector, (b) Notification Settings, (c) Current AQI Overview,
(d) AQI Notification, (e) Community Forum, (f) Preventive Measures,
(g) Explore Feature for Outdoor Activities, (h) Routes, (i) Map Feature

IV. RESULTS

The AirCompass application is able to represent real-time air quality information successfully by combining real-time AQI information from the WAQI and IQAir APIs. In load management and compliance with usage limits, the APIs are designed to be queried every two hours. The latest AQI values are fetched and shown in approximately two to three seconds when the data is updated manually inside the application, with feedback being offered quickly.

Through assistance for user-variable alert frequency based on AQI sensitivity, people can tailor alerts to their own health requirements. Its modular design ensures that its primary features, e.g., location-based alerts, pollution-sensitive route suggestions, and ancillary modules such as discussion forums and blogs, function properly.

V. CONCLUSIONS

The AirCompass attains its mission of providing a responsive, accessible air quality monitor. It does so both technologically and as a useful service through its reliable data management, real-time response to user refresh, and flexible alert setup configurations. Being capable of feature-scalable extensions such as wearable integration and predictive alert, the application is the foundation of future innovation for mobile environmental sensing tools.

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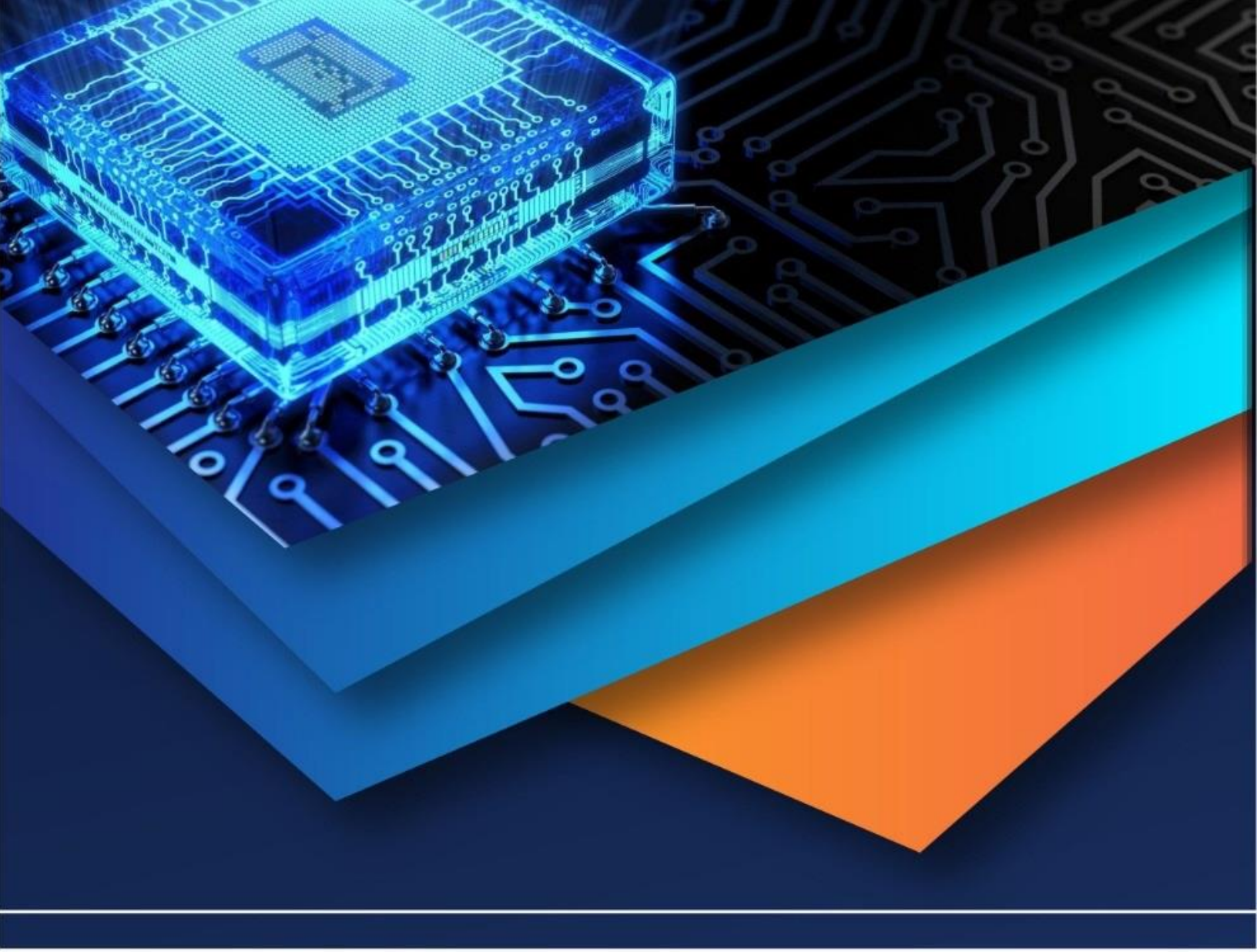

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