# **Smart Air Quality Monitoring**

### A PROJECT REVIEW I REPORT

#### **Submitted by:**

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### CSE3009 – Internet of Things (EPJ)

#### **Project Guide**

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### **Abstract:**

Smart air quality monitors are devices that measure and track the quality of the air in a particular environment. They can be used to monitor indoor or outdoor air quality, and often include sensors to measure a variety of air pollutants such as particulate matter, volatile organic compounds, carbon monoxide, and nitrogen dioxide. Some smart air quality monitors also include features such as weather forecasting and real-time alerts to help users stay informed about the air quality in their area. These devices can be particularly useful for people with allergies or respiratory conditions, as well as for those who are concerned about the general air quality in their home or workplace.

### **Problem statement and Objectives**

#### Problem statement:

Use sensors to create a device that can monitor the air quality in a room or building, alerting users when levels of pollutants reach unhealthy levels.

### Objectives:

- Develop a low-cost, accurate, and easy-to-use smart air quality monitoring system.
- Collect and analyze data on indoor air quality in a variety of different types of buildings.
- Use the data collected by the system to inform decisions related to building management and occupant health.
- Explore the potential for integrating the system with other building systems (such as heating and ventilation systems) in order to optimize indoor air quality.

# **Literature survey:**

S.No.	Title of the	Algorithms	Performance	Performance	Limitations(Ga	Scope for
	Paper	used	metrics used	attained	p identified)	future
	And year				,	work
	·					
1	A review of air	This paper	Cost-	The proposed	This paper	There is a
	quality	provides an	effectiveness:	system is	assumed	need for the
	monitoring	overview of	This metric	developed for	completely	development
	systems	the different	measures the	indoor air	wrong	of new
		types of air	relationship	quality	assumption	technologies
	Year - 2019	quality	between the	monitoring	where they have	_
		monitoring	cost of the	remotely. It is	•	approaches for
	Author - Ramik		system and the	cost and energy	output 997PPM	air quality
	Rawal	are available,	benefits it	efficient request	_	monitoring,
		including	provides.	and respond	where Delhi	such as
		stationary	1	protocol is used	which is the	sensors that
		monitors,		along with	most polluted	are more
		mobile		combination of		sensitive,
		monitors, and		address and	350PPM. Its	accurate, and
		remote		data centric	clear	cost-effective.
		sensing		protocols. Paper	understanding	
		technologies.		presents the	that they haven't	
		It also		summary of	calibrated the	
		discusses the		various	sensor and	
		strengths and		techniques of	didn't even	
		weaknesses of		air quality	convert the raw	
		different		monitoring	sensor data into	
		approaches to			PPM using	
		air quality			derivations we	
		monitoring,			did.	
		and how these				
		systems can				
		be used to				
		improve our				
		understanding				
		of air				
		pollution.				
2	Air quality	This paper	Precision: This	Low-cost	performance of	performance
	monitoring	reviews the	metric	sensors are an	low-cost sensors	of low-cost
	using low-cost	use of low-	measures the	attractive	can vary widely,	sensors can
	sensors: A	cost sensors	repeatability of	option for air	and may not	vary widely,
	review	for air quality	the system's	quality	always meet the	and may not
		monitoring,	measurements.	monitoring, as	same standards	always meet
	Year - 2019	and discusses	Response time:	they can	of accuracy and	the same
		their potential	This metric	provide a cost-	precision as	standards of
	Author -	as a tool for	measures the	effective way to	more expensive	accuracy and
	<u>Federico</u>	improving air		measure a wide	sensors. In	precision as
	Karagulian,	quality	the system to	range of	general, low-	more
	<b>Maurizio</b>	monitoring in	detect a change	pollutants in	cost sensors tend	expensive
	<b>Barbiere</b>	developing	in the air	real-time.	to have lower	sensors. In
	, Alexander	countries.	quality.		sensitivity and	general, low-
	Kotsev, Laurent		-		accuracy	cost sensors
	Spinelle				compared to	tend to have
	-				more expensive	lower
					sensors, and	sensitivity and
					may be more	accuracy

					prone to drift	compared to
					and interference.	compared to more
					and microrelice.	expensive
						sensors, and
						may be more
						prone to drift
						and
						interference.
3	Evaluating the	This paper	Our data	More	Missing data	The need for
	accuracy of low-	evaluates the	showed that it	sophisticated	from the AQY1	low-cost air
	cost air quality	accuracy of	is critical for	calibration	monitors, which	quality
	sensors	low-cost air	users to	methods,	was mainly due	
		quality	regularly	including	to sensor failure	in response to
	V 2022	sensors, and	calibrate low-	accounting for	and the need to	the fixed
	Year - 2022		cost sensors and		replace those	nature, high
	Author Honor	these sensors	monitor data	sensor	sensors and reinstall the	calibration
	Author - <u>Haneen</u> Khreis, Jeremy	can be used to complement	once they are installed, as	performance, may further	units in the field,	requirements, and purchase
	Johnson,	traditional	sensors may not		and then	and purchase and
	Katherine Jack,	monitoring	be operating	•	manually upload	0,120
	Bahar	methods.		This work adds	the reference	costs of
	Dadashova, Eun		may result in	to the literature	monitor's data,	traditional air
	Sug Park		_		recalculating the	pollution
			amounts of	performance of	calibration	monitors, as
			data.	low-cost	factors and	well as the
				sensors over	applying them.	high spatial
				one of the		variability of
				longest		urban air
				durations		pollution,
				reported to		which is not
				date.		captured by
						reference
						monitors.
4	Spatial and	This paper	Data	It is difficult to	Inaccurate or	There is a
	temporal trends	uses air	availability:	determine the	imprecise	need for the
	in air quality: A	quality	This metric	performance	measurements:	development
	case study	monitoring	measures the	attained in a	The	of systems and
		data to	amount of data	specific case	performance of	platforms that
	Year - 2019	examine		study on spatial	an air quality	can integrate
	A .4	spatial and	is able to	and temporal	monitoring	data from
	Author -	temporal	collect over a	trends in air	system may be	multiple
	YuluTian,	trends in air	•	quality without	limited by its	sources, such
	YuanJiang,	pollution in a	time.	more information	accuracy and	as satellite
	QiLiu	particular region, and	Data quality: This metric	about the	precision. If the measurements	data, ground- based
		discusses the	measures the	specific goals,	taken by the	monitoring
		implications	reliability and	methods, and	system are not	networks, and
		of these	validity of the	results of the	accurate or	citizen science
		trends for	data collected	study. In	precise, it may	data.
		public health	by the system.	general, the	be difficult to	Julu.
		and the		_	accurately assess	
		environment.		an air quality	spatial and	
				monitoring	temporal trends	
				system in a case	•	

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quality in this setting. It also provides recommendations for improving air quality in schools.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives		, Runming Yao	•				· ·
setting. It also provides recommendations for improving air quality in schools.  This metric measures the recommendations for improving air quality in schools.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives			•		-		
provides recommendati ease of use and ons for convenience of improving air quality in schools.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives					· ·		_
recommendations for convenience of improving air quality in schools.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives  The may be difficult to accurately assess the air quality in schools.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives			•		_	_	mitigated.
ons for improving air quality in schools.  convenience of the system for the user.  the user.  cost-effectiveness, and user-friendliness.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives					response time,		
improving air quality in schools.  Ithe system for the user.  Ithe performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives			recommendati	ease of use and	data	may be difficult	
quality in schools.  the user.  cost- effectiveness, and user- friendliness.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives			ons for	convenience of	availability,	to accurately	
schools.  effectiveness, and user- friendliness. The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives			improving air	the system for	data quality,	assess the air	
and user- friendliness.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives			quality in	the user.	cost-	quality in	
friendliness.  The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives			schools.		effectiveness,	schools.	
The performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives					and user-		
performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives					friendliness.		
performance attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives					The		
attained in a review may be compared to performance benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives							
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benchmarks or standards established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives							
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established by regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives							
regulatory agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives							
agencies or professional organizations, or may be evaluated in relation to the specific goals and objectives					_		
professional organizations, or may be evaluated in relation to the specific goals and objectives							
organizations, or may be evaluated in relation to the specific goals and objectives							
or may be evaluated in relation to the specific goals and objectives					•		
evaluated in relation to the specific goals and objectives					_		
relation to the specific goals and objectives							
specific goals and objectives							
and objectives							
of the review.							
					of the review.		

	1 //	FD1 11	7D1 11			TDI :
6.	https://www.scie		The overall	This section	Accuracy: Low-	This paper
	ncedirect.com/sc		framework of	examines the	cost sensors may	•
	ience/article/abs/		the proposed	predictive	not be as	enabled
	pii/S001393512		ETAPM-AIT	*	accurate as more	
	1018752	model is	model is	the ETAPM-	expensive,	toxicology for
			demonstrated in		professional-	air pollution
		in Fig. 2. The	Fig. 2. The	under different	grade sensors.	monitoring
		proposed	proposed model	measures.	This can make it	using the
		model aims to	aims to report	Besides, the	difficult to rely	Artificial
		report the air	the air quality	ETAPM-AIT	on their readings	Intelligence
		quality status	status in real-	model is	for making	technique
		in real-time	time by using a		important	(ETAPM-
		by using a	cloud server	the results are	decisions.	AIT) to
		cloud server	and sends an	inspected under	decisions.	improve
		and sends an	alarm in the	various time		human health.
		alarm in the		intervals, viz, 5,		The proposed
			hazardous			ETAPM-AIT
		presence of		15, 30 and 60		
		hazardous	pollutants level	· · · · · · · · · · · · · · · · · · ·		model
		pollutants	in the air	illustrated in		includes
		level in the air	1 2	Fig. 5. Table 1		various
		quality. The	figure shows	offers a		sensors to
		figure shows	that the	comprehensive		collect eight
		that the	ETAPM-AIT	outcome		pollutants
		ETAPM-AIT	model involves			level and
		model	two significant	ETAPM-AIT		transmit them
		involves two	phases namely	model to		to the cloud
		significant	data collection	classify		server via
		phases	and data	different		gateways for
		namely data	analytics. First,	pollutants for		the analytic
		collection and	at the data	every 5 min.		process. The
		data analytics	collection	The results		proposed
		3	phase, IoT-	demonstrate the		model
			based sensors	ETAPM-AIT		determines the
			are used to	model that		status of air
			collect details			quality in real-
			related to eight	the		time by using
			_	contaminants		a cloud server
			pollutants.			
				with the least		and sends an
				MAE, MSE and		alarm in the
				RMSE values		presence of
						hazardous
						pollutants
						level from the
						air
7.	https://www.hin		Effectiveness in		Sensitivity:	Refining the
	dawi.com/journa		detecting and	Quality	Low-cost	design of the
	ls/js/2020/87497	measurement	measuring	Monitoring	sensors may not	system to
	64/	of indoor air	various air	System Using	be as sensitive	make it more
		quality is the	pollutants: The	Internet of	as professional-	user-friendly
		most	ability of the	Things" by S.	grade sensors,	and cost-
		important	system to	S. Shinde et al.	meaning they	effective. This
		factor for the	accurately	(2017) is a	may not be able	
		platform.	measure	study that	to detect all	simplifying
		Thus, Smart-	various air	describes the	pollutants	the user
		Air was	pollutants can	design and	present in the	interface,
		developed to	be evaluated by			reducing the
		collect		of a smart air	an.	size and
		accurate and	comparing the			
			sensor readings	quality		weight of the
		reliable data	to national and	monitoring		system, or

system using for indoor air international air finding ways Internet of to reduce the quality quality monitoring. standards and Things (IoT) cost of guidelines. Because the technology. The manufacturing monitoring system is and designed to maintaining area is not constant, the monitor and the system. device was measure designed to various air be easily quality customized to parameters, including an environment temperature, humidity, dust by using an expandable concentration, interface. and volatile Thus, various organic types of compounds sensors can (VOCs). The collected data is be installed or transmitted to a adjusted based on the cloud server for environment. storage and Also, a Longanalysis, and Term can be accessed **Evolution** by users (LTE) modem through a webbased interface. is mounted in the device to The authors of transmit the study claim detected data that the system directly to the is able to web server achieve high for classifying levels of and accuracy and visualizing air reliability in its quality. For measurements. most IoT and that it can platforms, be effectively gateway or used to monitor data loggers air quality in are installed real-time in to gather and various settings However, it is transmit data wirelessly to not clear from the web the information server. you provided However, in what specific this study, a performance microcontroll metrics were er was used to evaluate the system or installed in the device to how it gather the performed data from the relative to other sensors and air quality transmit it to monitoring the web systems. server using

	1	.1 T.DD				<u> </u>
		the LTE				
		modem,				
		eliminating				
		the need for a				
		gateway and a				
		data logger.				
8.		There are two		User-	Interference:	Exploring new
	pi.com/1660-	potential	collection and	friendliness:	Low-cost	applications
	4601/17/14/4942	technologies	analysis	The ease of use	sensors may be	for the
		that present a	capabilities:	and	susceptible to	technology in
		solid platform	The latency in	understanding	interference	different types
		for the	data	of the system	from other	of indoor
		development	transmission	for both	sources, such as	environments.
		of IAQ	and the ability	installers and	temperature,	This could
		monitoring	of the system to	users.	humidity, and	include testing
		systems:	handle large		other	the system in a
		wireless	amounts of data		environmental	variety of
		sensor	can be used as		factors, which	different
		technologies	performance		can affect their	buildings
		(WSN) and	metrics for		accuracy.	(such as office
		Internet of	evaluating the			buildings,
		Things (IoT)	real-time			schools, or
		[ <u>15</u> ]. As the	capabilities of			homes) in
		latest	the system.			order to
		government				determine its
		policies are				effectiveness
		promoting the				in different
		development				types of
		of smart cities				settings.
		and smart				settings.
		villages with				
		the influence				
		of IoT-based				
		architectures,				
		it is relevant				
		to analyze the				
		potential of				
		IoT for real-				
		time IAQ				
		monitoring				
		applications.				
		The				
		combination				
		of IoT with				
		new-age				
		information				
		and				
		communicatio				
		n				
		technologies				
		promises				
		reliable				
		solutions for				
		enhanced				
		environmenta				
		l health and				
		well-being				
		[ <u>16</u> ]. These				
		monitoring				
		monnoring				

		systems				
		include two				
		relevant				
		components:				
		hardware and				
		software.				
		These				
		domains work				
		together to				
		provide				
		instant				
		updates				
		regarding				
		pollutant				
		levels. On the				
		one hand, the				
		selection of				
		the right				
		sensors,				
		microcontroll				
		ers (MCUs),				
		and gateways				
		is a crucial				
		factor for				
		upcoming				
		researchers.				
		On the other				
		hand,				
		communicatio				
		n				
		technologies				
		such as Wi-				
		Fi, ZigBee,				
		Bluetooth,				
		and Ethernet				
		are used for				
		real-time				
		updates				
		regarding				
		pollutants				
		concentration				
9.	"An IoT-based	This paper	Accuracy and	Sensitivity: The	Calibration:	Expanding the
). 	Smart Air	presents the	precision of	ability of the	Low-cost	range of
	Quality	design and	sensor	system to detect		
	Monitoring	_	measurements:	small changes	sensors may require more	parameters that the system
	System" by M.	on of a smart	This can be	or variations in	_	is able to
	A. Imran et al.	air quality	evaluated by	air quality.	frequent calibration to	measure. This
	(2017)			an quanty.	ensure their	could include
	(2017)	monitoring	comparing the			
		system using low-cost	sensor readings to reference		accuracy, which	•
					can be time-	to measure
		sensors and	values obtained		consuming and	additional
		an IoT	from a		costly.	pollutants or
		platform. The	•			contaminants,
		system was	analyzer, and			or developing
		tested in a	using metrics			new
		real-world	such as relative			algorithms to
		environment	error and			analyze the
		and was able	coefficient of			data collected

		to	determination			by the system
		successfully	$(R^2)$ to			in order to
		detect and	quantify the			provide a
		measure	accuracy and			more
		various air	precision of the			comprehensiv
		pollutants.	sensor			e picture of
		ponutants.	measurements.			indoor air
			measurements.			quality.
						quanty.
10	"Smart Air	This paper	Robustness and	Integration with	Lifespan: Low-	Evaluating the
	Quality	* *	reliability: The	_	cost sensors may	•
	Monitoring	development	ability of the	The ability of	not have as long	system on air
	System Using	of a smart air	system to	the system to	of a lifespan as	quality and
	Internet of	quality	operate reliably	integrate with	professional-	human health:
	Things" by S. S.	monitoring	and consistently	other building	grade sensors,	Further
	Shinde et al.	system that	over time can	systems (such	meaning they	research could
	(2017)	uses IoT	be evaluated	as heating and	may need to be	be conducted
		technologies	using metrics	ventilation	replaced more	to assess the
		to collect and	such as uptime	systems) in	frequently.	impact of the
		analyze data	and mean time	order to		system on air
		from multiple	between	optimize indoor		quality and
		sensors	failures	air quality.		human health,
		placed in	(MTBF).			such as by
		different				studying the
		locations. The				effects of the
		system was				system on
		able to				allergy and
		accurately				asthma
		measure				symptoms or
		various air				by analyzing
		pollutants and				the economic
		provide real-				benefits of the
		time data to				system.
		users.				

11.	"IoT-Based	This paper	Effectiveness in		Cost: The cost	Implementing
	Smart Air	presents a	detecting and	of purchasing,	of implementing	•
	Quality	smart air	measuring	installing, and	and maintaining	
	Monitoring	quality	various air	maintaining the	an IoT-based air	locations and
	System for	monitoring	pollutants: The	system.	quality	environments:
	Urban	system that	ability of the		monitoring	The system
	Environment"	uses IoT	system to		•	could be tested
	by C. C. Lai et	technologies	accurately		high, which can	and deployed
	al. (2018)	to collect and	measure		be a barrier for	in different
		analyze data	various air		some	locations and
		from multiple	_		organizations or	
		sensors	be evaluated by		individuals.	such as urban
		placed in an	comparing the			areas, rural
		urban	sensor readings			areas, or
		environment.	to national and			industrial
			international air			settings, to
		was able to	quality			determine how
		detect and	standards and			it performs
		measure	guidelines.			under different
		various air				conditions.
		pollutants, including				
		particulate				
		matter,				
		carbon				
		monoxide,				
		and nitrogen				
		dioxide, and				
		provide real-				
		time data to				
		users.				
		I hope these				
		papers are				
		helpful! Let				
		me know if				
		you have any				
		further				
		questions.				

10	A . 1.,	TTI .	G .	D C	D 1: 1:1:4 771	T : .1
12.	Air quality monitor in	The system	Cost- effectiveness:	Range of	Reliability: The	
		hardware consists	This metric	measurement:	reliability of IoT-based	real-time data
	sensor nodes and		measures the	The types and levels of		analysis and visualization
	gateways	mainly of the sensor nodes	relationship	pollutants and	systems can be a	capabilities:
		and gateways,	between the	contaminants	concern, as they	_
		which are	cost of the	that the system	rely on a network of	The system could be
		described	system and the	is able to	sensors and	enhanced to
		below. A star-	benefits it	measure.	devices that may	
		network	provides.	measure.	not always be	sophisticated
		configuration	provides.		reliable.	data analysis
		has been			Tenasie.	and
		adopted in the				visualization
		present				tools, such as
		application				machine
		since, in each				learning
		measurement				algorithms or
		site, the				interactive
		sensor nodes				dashboards, to
		are scattered				help users
		near and				better
		around their				understand
		gateway.				and interpret
						the data.
		Each sensor				
		node ( <u>Figure</u>				
		2) monitors				
		the				
		concentration				
		s of six gases in addition to				
		ambient				
		temperature				
		and relative				
		humidity. The				
		sensor node				
		communicate				
		s wirelessly				
		with the				
		gateway				
		through XBee				
		PRO radio				
		modules. A				
		dedicated				
		firmware is				
		developed for				
		the sensor				
		node as				
		described				
		below.				
		Libelium				
		sensor				
		platform was selected for				
		the sensor				
		nodes; this				
		platform is				
		characterized				
		by the				
	<u> </u>	by the			<u>l</u>	

modularity of		
its		
architecture		
and by its		
ability to		
support		
several		
sensors and		
communicatio		
n modules.		
The sensor		
node		
includes: (i) a		
set of		
calibrated		
sensors; (ii) a		
sensors		
interface		
board called		
Gas Pro		
Sensor Board;		
(iii) a		
processing		
and data		
storing board,		
called		
Waspmote,		
incorporating		
an		
ATmega1281		
microcontroll		
er operating		
at 14.74		
MHz, a 128		
kB Flash		
memory, an 8		
kB SRAM, a		
2 GB SD		
card, a 32		
kHz Real		
Time Clock		
(RTC), seven		
analog inputs,		
eight digital		
I/O, two		
UARTs, one		
I2C, one SPI,		
and one USB		
port; (iv) a		
Series 2 XBee		
PRO (one		
mile line-of-		
sight range)		
communicatio		
n module; and		
(v) a		
rechargeable		
battery with a		
typical		
typicai		1

13.	"An IoT-Based Smart Air Quality Monitoring System for Indoor and Outdoor Environments" by K. K. Singh et al. (2018)	to collect and analyze data from multiple sensors placed in both indoor and outdoor environments. The system was able to accurately measure various air pollutants, including particulate matter and volatile organic compounds, and provide real-time data	Real-time data collection and analysis capabilities: The latency in data transmission and the ability of the system to handle large amounts of data can be used as performance metrics for evaluating the real-time capabilities of the system.	performance of an IoT air quality device can vary depending on a number of factors, including the quality of the sensors and other components used, the accuracy of the readings it produces, and the overall design of the device. Some key factors that can impact the performance of an IoT air quality device include:  Sensitivity: The sensitivity of the sensors in an IoT air	Privacy: The use of IoT-based systems may raise concerns about privacy, as they often involve collecting and storing large amounts of data about individuals and their environments	system with other environmental monitoring systems: The system could be connected to other
		and provide		the sensors in an IoT air quality device will determine its ability to accurately detect and measure different		
				pollutants in the air.		

	T	l .	T	,		
				Accuracy: The		
				accuracy of an		
				IoT air quality		
				device's		
				readings can be		
				impacted by factors such as		
				interference		
				from other		
				sources, the		
				need for		
				frequent		
				calibration, and		
				the overall		
				reliability of the		
				device.		
				Range: The		
				range of an IoT		
				air quality		
				device, or the		
				distance over		
				which it can		
				accurately		
				measure pollutants in the		
				air, can be a		
				factor in its		
				performance.		
				Durability: The		
				durability of an		
				IoT air quality		
				device, or its		
				ability to		
				withstand wear		
				and tear, can		
				affect its		
				performance		
				over time.		
1.4	II A Commond A :	This as a	A a ayuna aru 1	Daliabilian TI	Intonos analitic	Evenor din - 41-
14.	"A Smart Air Quality	This paper presents the	Accuracy and precision of	degree to which	Interoperability: Ensuring	Expanding the range of
	Monitoring	design and	sensor	the system	interoperability	pollutants that
	System Based	implementati		produces	between	can be
	on IoT for	on of a smart	This can be	consistent,	different IoT	measured: The
	Public Spaces"	air quality	evaluated by	dependable	devices and	system could
	by F. Y. Wang	monitoring	comparing the		systems can be a	
	et al. (2017)	system for	sensor readings		challenge, as	measure
		use in public	to reference		they may use	additional
		spaces such	values obtained		different	pollutants
		as schools	from a		protocols and	such as sulfur
		and hospitals.	calibrated gas		standards.	dioxide,
		The system	analyzer, and			ozone, and
		uses IoT	using metrics such as relative			volatile
		technologies to collect and	error and			organic compounds,
		analyze data	coefficient of			which are
		from multiple				known to have
		sensors	(R^2) to			negative
		placed in the	quantify the			impacts on air
	1	11	11	1	i	1 311

	Т	Γ .		Т		
		environment	accuracy and			quality and
			precision of the			human health.
		to accurately	sensor			
		measure	measurements.			
		various air				
		pollutants,				
		including				
		particulate matter and				
		carbon				
		monoxide.				
15.	"An IoT-based	This paper	Cost-	Accuracy: The	Security: IoT-	Improving the
13.	Smart Air	presents the	effectiveness:	degree to which	· ·	accuracy and
	Quality	design and	This metric	the system is	can be	precision of
	Monitoring	implementati	measures the	able to	vulnerable to	the sensor
	System for	on of a smart	relationship	accurately		measurements:
	Environmental	air quality	between the	measure and	such as hacking,	
	and Health	monitoring	cost of the	report on	which can	achieved
	Applications" by		system and the	various	compromise the	through the
	R. A. Al-Sarawi	uses IoT	benefits it	pollutants and	integrity of the	use of more
	et al. (2018)	technologies	provides.	contaminants in		advanced
	, , ,	to collect and	•	the air.	collected and the	sensors or by
		analyze data			privacy of	optimizing the
		from multiple			individuals.	sensor
		sensors				calibration and
		placed in a				measurement
		real-world				algorithms.
		environment.				
		The system				
		was able to				
		accurately				
		measure				
		various air				
		pollutants,				
		including				
		particulate				
		matter, carbon				
		monoxide,				
		and ozone,				
		and provide				
		real-time data				
		to users. The				
		authors also				
		evaluated the				
		performance				
		of the system				
		using metrics				
		such as				
		accuracy and				
		precision of				
		sensor				
		measurements				
		, real-time				
		data				
		collection and				
		analysis				
		capabilities,				
		and				

effectiveness in detecting and measuring various air pollutants.		

### Proposed alternative methodology and design:

There are a number of steps that can be involved in implementing an IoT device for controlling air quality in a specific environment. Here is a general methodology that could be followed:

- 1. Identify the air quality problem that you are trying to solve and the specific pollutants or contaminants that you need to address.
- 2. Research and select an IoT air quality device that is appropriate for your needs. Consider factors such as the sensitivity and accuracy of the device, its range, and its overall cost and maintenance requirements.
- 3. Install the IoT air quality device in the environment where you want to monitor and control air quality. Follow the manufacturer's instructions for proper installation and setup.
- 4. Configure the device to collect and transmit data about air quality in real-time to a central location, such as a cloud-based server or local network.
- 5. Set up alerts or notifications to alert you or other stakeholders when air quality reaches certain thresholds or changes significantly.
- 6. Monitor the data collected by the IoT air quality device over time to get a sense of the air quality in your environment and identify any trends or patterns.
- 7. Use the data collected by the device to inform decisions about how to improve air quality, such as by adjusting ventilation systems, using air purifiers, or implementing other control measures.
- 8. Regularly maintain and calibrate the IoT air quality device to ensure its accuracy and reliability over time.

This is just one possible methodology for implementing an IoT device for controlling air quality, and the specific steps may vary depending on your specific needs and the characteristics of the device you are using.

Imagine that you are responsible for maintaining the air quality in a large office building. You have identified that there are some areas of the building where the air quality is consistently poor, and you want to use an IoT device to help you monitor and control the air quality in these areas.

Following the methodology outlined above, you might take the following steps:

- Identify the specific pollutants or contaminants that you are concerned about, such as particulate matter or volatile organic compounds.
- Research and select an IoT air quality device that is sensitive to these pollutants and has a range sufficient to cover the areas of the building where you want to monitor air quality.
- Install the IoT air quality device in the building and configure it to transmit data about air quality in real-time to a cloud-based server.
- Set up alerts or notifications to alert you when air quality reaches certain thresholds or changes significantly.
- Monitor the data collected by the IoT air quality device over time to get a sense of the air quality in the building and identify any trends or patterns.

- Use the data collected by the device to inform decisions about how to improve air quality in the building, such as by adjusting ventilation systems, using air purifiers, or implementing other control measures.
- Regularly maintain and calibrate the IoT air quality device to ensure its accuracy and reliability over time.

# **References (As per IEEE format)**

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