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## **Pradnyaa International Journal of Multidisciplinary Research**

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# Block-Chain Management: A solution to reduction in NPA of UCBs

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## ABSTRACT

Digital technology has become a disruptive force and is increasingly becoming a critical factor, not only in banking sector, however, across a variety of industries all around the world. It has changed the how business operate by changing the entire business models and has gained remarkable interest in all sectors. Various industries are now customizing and personalizing the Block chain technology to fit their needs and generating multiple use cases. The technology is employed to provide a decentralized method for app creation. The framework/architecture of Block-chain technology in the banking process is explained in this article. It also discusses the features and benefits of Block chain, and how to utilize block chain to enhance the KYC procedure and reduce bank NPAs, with particular attention to cooperative banks. In addition, the research assumption is used in the formation of a questionnaire focusing on significance of block chain management in reducing NPA in UCBs in Mumbai region.

**Keywords:** *Blockchain, Architecture of Blockchain, Blockchain in Banking, Blockchain in KYC, Security Aspects in Blockchain, NPA.*

## 1. INTRODUCTION

Each block in a blockchain has a timestamp and a link to a prior block; a blockchain is a decentralised, distributed database that is used to store a continuously growing list of documents called blocks. Blockchain's are naturally resistant to data alteration because of their purpose and construction. A block can theoretically work as "an open, distributed ledger that can record transactions between two parties effectively, in a verifiable, and permanent way." Blockchain, also known as Distributed Ledger Technology, is the main technology that underpins bitcoin. Processes can become more safe, efficient, transparent, and dependable thanks to blockchain technology. The significance of blockchain technology development has been recognised by businesses and the media worldwide.

Due to the digitalization of records, a huge volume of data gets generated daily. It becomes important for every organization to protect its data from security threats in a cost-effective manner. Blockchain technology is capturing the attention of chief executives because it assures invariability, cryptographic security of data, and decentralized ownership. First to dip their feet were the financial institutions. More than 90 central banks were engaged in worldwide conversations about blockchain, according to the World Economic Forum, and as a result, banks are prepared to test out several blockchain prototypes in 2017. Blockchain has also gained a lot of importance in non-financial industries like supply chain management, crowd funding, telecom cyber security, the insurance industry, retail, etc.

Humankind has always exhibited cooperation. Cooperation will inevitably play a significant and beneficial role in the global economy. Even the global development of cooperatives has not been a straight line, and the cooperative movement has clarified the dynamic character of

cooperative activities that suit the local and regional environment, in addition economic and social situations, at various times. In India, the banking industry has a significant impact on the country's growth. There are cooperatives in almost every village in India. Cooperative organisation is one of the most crucial elements for the underprivileged part.

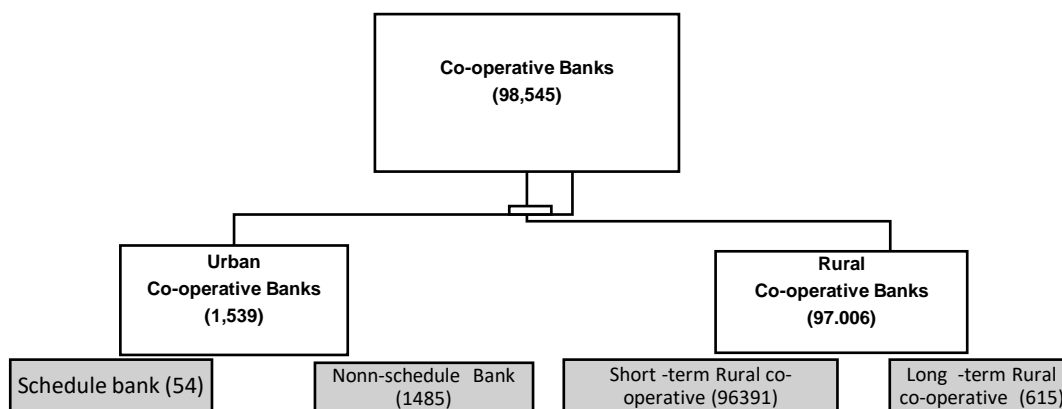
### 1.1 TYPES OF CO-OPERATIVES BASED ON STRUCTURE

The co-operative banking structure in India includes the following two main types:

- Urban Co-operative Banks
- Rural Co-operative Banks

According to the RBI survey report 2019-20, India had 98545 co-operative banks, of which 1539 were urban co-operative banks and the remainder, or 97006, were rural co-operative banks. UCBs' total assets grew from 1,32,145 crores in 2004-05 to 6,23,905 crores in 2019-20. It equates to a 71 percent increase over a 15-year period. The information amply demonstrates the significance of UCBs in the Indian banking industry. The basic origin of the cooperative movement in India comes from Maharashtra. The social and economic advancement of Maharashtra state was significantly influenced by the cooperative movement. Based on the data reported by UCBs in off-site returns, the total number of UCBs in India was 1539, of which 494 existed in the state of Maharashtra alone. This means that approximately 33% of UCBs in Maharashtra are alone. The total number of UCB branches in Maharashtra is 6620, accounting for 60% of all UCB branches in India. Deposits collected and advances given are also the highest in comparison to other states in India, at 314210 Cr. and 193136 Cr. by the fiscal year 2019-20. It shows the massive contribution of Maharashtra state in the urban cooperative sector. In a megacity like Mumbai is the most populated, city in India, the role played by UCB is very vital. The total number of UCB branches operating in Mumbai in 2019-20 was 60. It not only accepts the deposits but additionally offers them a credit facility for their developments. The UCBs in Mumbai really help the population attain their socio-economic objectives.

**Chart 1: Cooperative Bank Structure**



Source: Trend and Progress Report 2019-20(RBI)

### 2. NON-PERFORMING ASSET:

Non-performing assets, or NPAs, are used in banking and finance. The amount that has not been recovered will be considered a non-performing asset (NPA) if a bank or finance firm is unable to get back the money it has provided to the borrower in 90 days. It stands for bad loans whose debtors did not fulfil their payback requirements.

## 2.1 TYPES OF NPA

NPA may be classified into

### a. **Gross NPA**

Gross non-performing assets (NPAs) are advances that are thought to be unrecoverable, for which banks have made provisions, but which are nonetheless recorded in the banks' books of account.

### b. **Net NPA**

Net NPA is calculated by subtracting from Gross NPA factors like unpaid interest, partial payments, and accounts held in suspense.

### **NPA and UCB:**

The RBI said that the number of UCBs has declined from 1926 in March 2004 to 1539 in March 2020 based on off-site surveillance returns, indicating that the UCB has experienced a number of problems over time. It means that there were financial issues facing the UCB in India. The result is the RBI took the initiative to close a number of financially weak banks. Further sector consolidation as a result of the number of mergers and acquisitions at UCB from 2004 to 2020. Between 2004-05 and March 2020, a total of 387 UCB 136 were merged and remained. In Maharashtra, a total of 73 UCBs were merged and closed. It was the highest as compared to any other state in India. In Mumbai, UCBs like Panjab Maharashtra Co-operative Bank, CKP Co-operative Bank, Kapol Co-operative Bank, etc. are also subject to the restrictions of the RBI. The asset quality of UCBs is also declining due to non-performing assets. The number of poor investors who suffer the incidental loss of their life savings of PMC banks, CKP banks, and Kapol Co-operative banks.

## 3. REVIEW OF LITERATURE

The results of a review of the pertinent literature are listed below.

**Tejal Shah (2018)**, in her research paper on "'Blockchain Technology in Banking and Finance" This essay seeks to describe both the structure and operation of the blockchain technology. Along with the Blockchain's numerous features, its advantages are also explored. For a select few banking transactions, the use cases and blockchain suitability assessments have also been completed. We also look at the Blockchain's security features in the final segment.

**A. Shanti Bruyn (2017)**, Give details about the blockchain technology, its background, and how it operates in your "Blockchain" research paper. The report also provides background on the development of blockchain technology. Finally, it discusses how the many variables within blockchain interact with one another in more detail.

**Arati Dua (2017)**, According to her writings on "Banking on Blockchain" that were published in today's business, block chain technology is used in the banking industry when a corporate customer's suspicious transaction with another bank is not revealed by a bank's know-your-customer (KYC) check. What if banks were able to communicate corporate KYCs, including investigation reports and cross-border wire transfer reports, in real time while also making money off of them on a shared digital ledger that was private, secure, immutable, and based on consensus?

**Anuj Sharma (2014)**, International Journal of Computer Applications research articles on "Reducing Risk in KYC for Large Indian Banks by Using Big Analytical Techniques" This essay aims to examine the Know Your Customer process, outline the difficulties it faces, and draw attention to the inadequacies of current methods for successfully putting KYC regulations into practise (particularly in large Indian banks). It then proposes a convincing solution using Big Data analytical approaches like Fuzzy Matching & Map Reduce while leveraging real-

world examples. The authors are convinced that the solution's framework, which has been supplied, may quickly result in a functional prototype.

#### 4. OBJECTIVES

The following are the broad objectives of this research paper:

1. To understand the framework/architecture of Blockchain in Banking Sector.
2. To perform cost benefit analysis after using Blockchain management.
3. To suggest the use of block chain management to control NPA

#### Hypothesis:

H<sub>1</sub>: Blockchain Technology significantly helping in reducing NPA in UCBs in Mumbai

H<sub>0</sub>: Blockchain Technology is not significantly helping in reducing NPA in UCBs in Mumbai

#### 5. RESEARCH METHODOLOGY

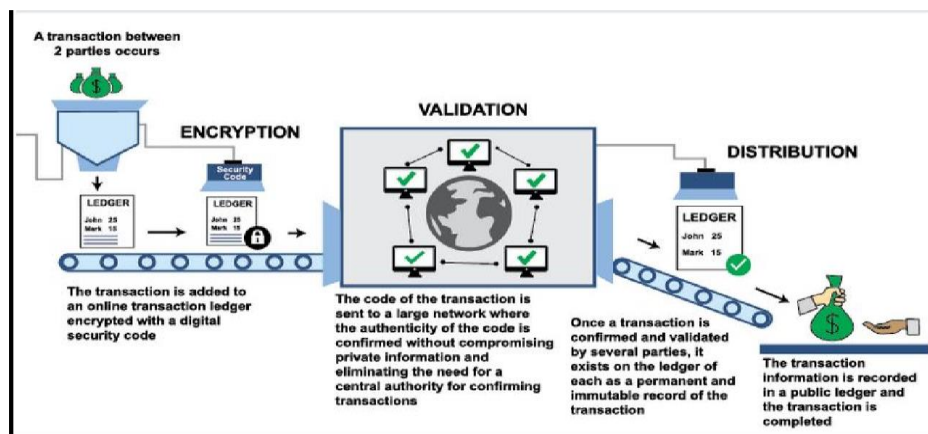
The current study is analytical because it uses statistical information. The study is supported by both primary and secondary data. The 239 respondents who completed the structured questionnaires, mainly the staff of 12 UCBs in the Mumbai district, provided the primary data. The primary sources of secondary data collection include online sources like papers, journals, and websites. While data analysis is carried out using Excel and SPSS software, data is displayed with the use of graphs, charts, tables, etc. The following list includes the statistical tools used:

1. Mean in mathematics used to compute values for evaluation purposes.
2. Analysis and elucidation using ANOVA and the Friedman's Test.

Framework of Blockchain:

Decentralization, digital signatures, data mining, and integrity are just a handful of the fundamental ideas that make up the blockchain framework.

Chart 2: Blockchain Decoded

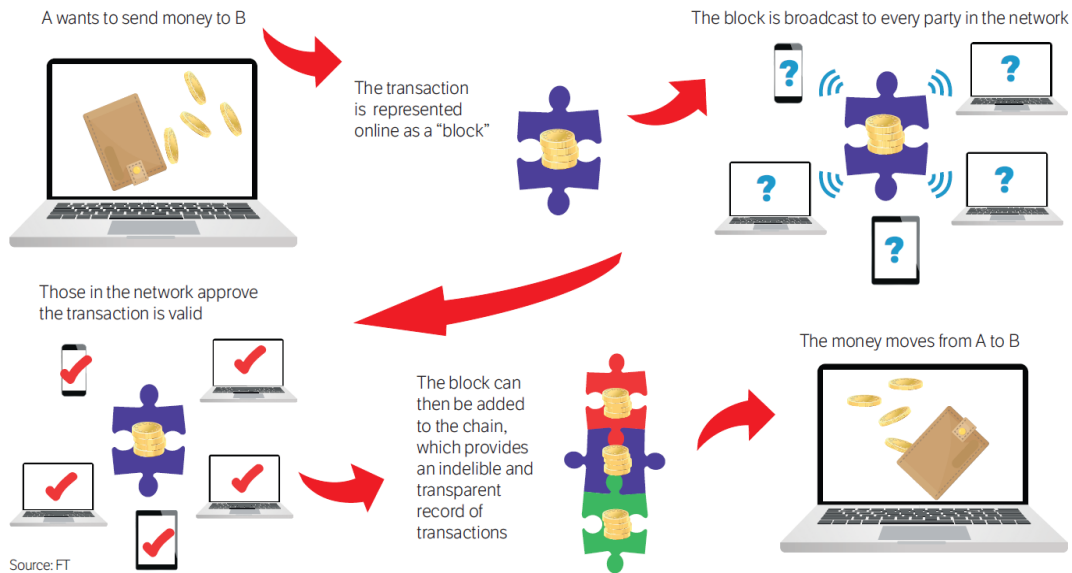


- (i) Decentralization: Blockchain distributes power across all participants in the transaction chain, rather than retaining a single central authority to control all other actors.
- (ii) Digital signature: Blockchain uses a unique digital sign to facilitate the sharing of information using public and private keys. Everyone on the network is aware of the public key, while the sender of the information is the only one who is aware of the private key.
- (iii) Data Mining: In a distributed network system, each miner digs deeply into the data, which



is then assessed in accordance with the encryption standards. Miners are also acknowledged for the confirmation and verification of the transactions.

(iv) Integrity: Transaction data is protected against manipulation once it has been agreed upon through the use of sophisticated algorithms and user consensus. In order to reduce the danger of fraud, data saved on blockchain serves as a single source of truth for all parties. Chart 3 : Work of Blockchain



## 6. ANALYSIS OF DATA:

Axis Bank is the country's third-largest private sector bank. The Bank offers the whole spectrum of financial services to a variety of customer groups, including big and mid-sized firms, MSME, agro, and retail businesses. Axis Bank, one of the earliest new generation private sector banks, began operations in 1994. Let's look at Axis Bank, which used block chain in its operations in 2017-18. The table below illustrates the advantages of block chain management in the context of Axis Bank.

**Table 1: Axis Bank KYC on Blockchain and cost-benefit analysis**

Particulars	FY 17-18 (Without blockchain)	FY 19-20 (With blockchain)
KYC Cost/Account (FY 17-18 approx. Rs. 500-2000, FY 19-20 approx. \$5) (1)	Rs. 500.00	Rs. 360
# Of Axis Bank customers (crore) (2)	4.7	5.4
Total # of banking relationship/customers (3)	2	2
Total # of KYC that needs to be done (crore) (4)=2*3	9.4	10.8
KYC cost (5)=1*4	Rs. 4700.00	Rs. 3888.00
Savings because of blockchain (crore)		Rs. 812.00
Net Profit (crore)	Rs. 275.68	Rs.1627.0 0
Retained Earnings	Rs. 1732.58	Rs. 2458.58
Shares outstanding (crore)	244.51	244.51

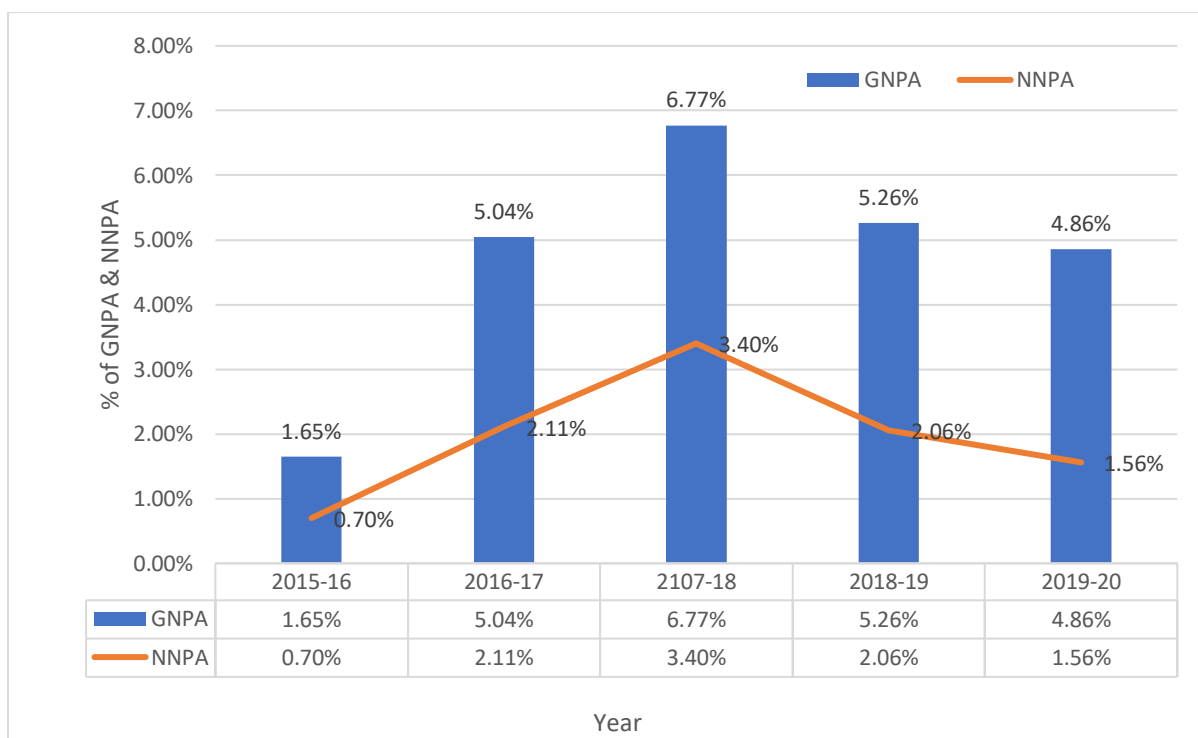
<b>Reported EPS</b>	<b>Rs. 1.13</b>	<b>Rs. 5.99</b>
<b>Absolute increase in EPS (with KYC on blockchain)</b>		<b>Rs. 5.96</b>
<b>% Increase in Net Profit (with KYC on blockchain)</b>		<b>529%</b>
<b>% Increase in EPS (with KYC on blockchain)</b>		<b>527%</b>
EPS: Earnings per share, 1 USD = 69 INR (FY 17-18), 1USD = 72 INR (FY 19-20)		

Source: Annual Report of Axis Bank

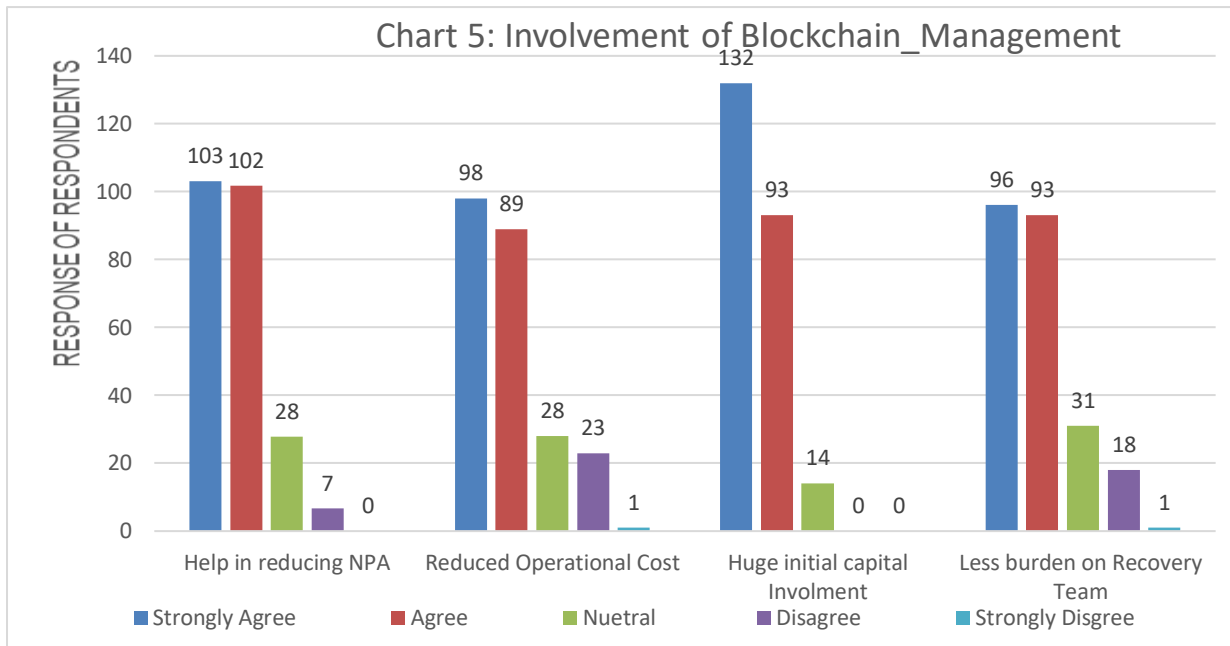
In the above table 1, it is indicated that the cost of KYC without Aadhar is INR 500–2000 (USD 7–30), whereas the cost of KYC on the blockchain is less than USD 5. So, assuming 1 USD = 72 INR, the cost of KYC using blockchain will be 72 x 5 = INR 360 crores.

Before blockchain, the total KYC cost was INR 4700 crores, whereas after implementing blockchain, the cost was reduced by INR 812 crores to INR 3888 crores. Thus, the reported net profit of Axis Bank was INR 275.69 crores in FY 17–18, which increased to INR 1627 crores in FY 19–20, which is an increase of 490%.

**Chart 4: GNPA and NNPA % of Axis Bank**



According to Chart 4, the ratios of gross and net non-performing assets (NPAs) decreased from FY 17–18 to FY 19–20. The total NPA was 6.77 percent in 2017–18 and dropped to 4.86% in 2019–20. A similar decline was seen in the net NPA ratio, which went from 3.40% in 2017–18 to 1.56% in 2019–20. demonstrates how well block chain technology works to cut down on problematic loans. The case of Axis Bank clearly shows that the block chain not only helps to reduce the KYC cost, but it is also a great method to manage the problems of bad loans. Using a systematic questionnaire, the researcher obtained first-hand information from 239 persons. The below chart 5, gives idea about involvement of blockchain management.



Source: Researcher Compilation

As per the above chart 5, 86% of respondents agree that blockchain technology helps in reducing NPA. 78% of respondents agreed that blockchain technology required less operational cost for NPA management, and 79% agreed that it helped relieve the recovery team's burden. At the same time, 94% of respondents felt that blockchain management required huge initial capital investment and maintenance.

The above-mentioned data of respondents is analysed using IBM-SPSS software, and one-way ANOVA is applied as follows:

Particular	N	Minimum	Maximum	Mean	Std. Deviation
Involvement Blockchain	239	1.00	2.00	1.2845	.45213
Help in reducing NPA	239	2.00	5.00	4.2636	.76255
Reducing Operational Cost	239	1.00	5.00	4.0879	.97264
Huge Initial Cost Investment	239	3.00	5.00	4.4937	.60717
Less burden on Recovery Team	239	1.00	5.00	4.1088	.92847

Source: Researcher -generated according to the primary data as per IBM SPSS software.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.850	.777	5

Source: Researcher -generated based on the primary data as per IBM SPSS software.

As per table 3, indicates the validity of data for the involvement of blockchain management the Cronbach's Alpha score is 0.850. If  $\alpha \geq 0.8$  then data set is reliable for testing. As  $\alpha = 0.850$  which indicates the above data set excellent or very reliable for the testing.

		Sum of Squares	df	Mean Square	F	Sig.
Help in reducing NPA.	Between Groups	8.160	1	8.160	14.849	.000
	Within Groups	130.234	237	.550		
	Total	138.393	238			
Reducing Operational Cost	Between Groups	11.814	1	11.814	13.124	.000
	Within Groups	213.341	237	.900		
	Total	225.155	238			
Huge Initial Cost Investment	Between Groups	24.568	1	24.568	92.171	.000
	Within Groups	63.172	237	.267		
	Total	87.741	238			
Less burden on Recovery Team	Between Groups	11.252	1	11.252	13.752	.000
	Within Groups	193.920	237	.818		
	Total	205.172	238			

Source: Researcher -generated according to the primary data as per IBM SPSS software.

### Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Involvement_Blockchain = Yes and No occur with probabilities 0.5 and 0.5.	One-Sample Binomial Test	.000	Reject the null hypothesis.
2	The categories of Help_in_reducing_NPA occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.
3	The categories of Reducing_Operational_Cost occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.
4	The categories of Huge_Initial_Cost_Investment occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.
5	The categories of Less_burden_on_Recovery_Team occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Source: Researcher -generated according to the primary data as per IBM SPSS software

As per Table 4, the Anova with Friedman's Test is applied to test the hypothesis. The Anova result as given in Table 4 shows that the 95% confidence level of significance is 0.05. The F value is less than that, i.e.,.000. It is understood that blockchain techniques is important measures that reduced the NPA. Therefore, the null hypothesis "blockchain technology is not significantly helping in reducing NPA in UCBs in Mumbai," i.e., is rejected.

## 7. FINDINGS

Block chain technology is used by prominent banks in India to reduce their overall operating costs.

These technologies also help banking sector to reduce the NPA. Axis Bank, ICICI bank, Kotak Mahindra banks are successfully implemented block chain in their operation. It means only Private bank took the initiatives.

The employees of UCBs also feel that blockchain management will help the cooperative banks reduce their NPAs.

One of the main worries is that the initial investment required to implement block chain is very large, and other banks may not find it appropriate for us.

If the UCBs want to stay in the business, then blockchain management will really benefit in the future by reducing cases like PMC bank crises, CKP bank crises, Kapol bank crises, etc.

## 8. CONCLUSION:

Though blockchain has enormous potential, banks must recognize the key features of this technology and how they can use it to solve their current business problems. It can also use this technology to exchange data, which also involves an exchange of value. Banks need to identify various opportunities, decide on the feasibility of implementation, and also consider the impact on existing processes. However, the question arises about the security framework, the cost of implementation, and other risks associated with it. As a result, they will have a deeper understanding of the technology, reduce risk, and be able to create a solution that is tailored to their particular problems.

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# “Female Teenager’s approach towards Entrepreneurship in Kalyan and Dombivali Region”

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## **ABSTRACT**

Entrepreneurship working was practices in India and all over the globe since many years. Entrepreneurship needs the logical idea which solves the problem of society, acquisition of funds and even family – peer group support which develop the confidence in the individuals. In India, Mainly Family business concepts was highly practiced and after the retirement of the owner which we called him as a “Karta” served the Business Responsibility to their male child and female child access the home responsibilities like cooking and other house-hold activities. Daughters hardly access to business activities and even pre-independence day’s they even don’t have the share in the family properties. Many Entrepreneurs keep some shares or even part of share of profit to their male and female child also. During pre-independence, females hardly get education and normally preferred that their girl child get married in a early age and lack of access to business activities. Post-Independence period normally saw the positive change in getting the various facilities in terms of getting education, jobs, entrepreneurship’s etc. Central and State Government have framed many polices to empower the female in terms of getting many rights for their self-development in terms of education and even get participate in entrepreneurship aspects. As we are living in the 21<sup>st</sup> Century still we see the female teenagers are accessing education and job opportunities to get developed in various sectors. Public sector and private sector organizations provides job opportunities to the male as well as the female and many educational institutions provide campus recruitment services to both the genders which provide an equal opportunity for their self-development and get self-reliant in their life. The main thing behind that the support from Family is very important but the same thing whether it is applied towards female teenager’s in Entrepreneurship or not?

**Keywords:** *Entrepreneurship, Pre-independence period, Post-independence period, stereotype.*

## **1. INTRODUCTION**

Entrepreneurship is a practice of creating self-employment and creation of money for self and for those who help them to create value for the society. As it is practiced all over the global level, In India, During Pre-independence period, the male dominated the society by which they are the only people have a right to earn income where as women was supposed to take the family and home responsibilities. Orthodox mentality people hardly provide opportunities for the women to take education and very few get the chance to work and earn some money for their family. Banking sector was not fully developed to provide loans to mass audience. Few banks were nationalized and banking sector was on the introduction stage where new banks are

coming to get established in a market for lending the loans and accepting the deposits. During pre-independence period, many banks don't lend money to women's due to non-present of collateral assets to keep it as a security and take the loan. Lack of family support, education issues, unawareness about the working of entrepreneurial activities, absence of counseling and mentoring, lack of confidence due to non-availability of funds and no motivation from family. These are the issues faced by women during the pre-independence period. Many social reformers like the symbol of Knowledge – Dr. Babasaheb Ambedkar, Mahatma Jyotirao Phule, Savitri-bai Phule, Fatema Shaikh and many more who fought for the rights, dignity and self-respect of women during that period and after Post- independence the nation and the globe is acknowledge their work, efforts towards the development of women's in each and every sector. After post-independence, the industrial sector got a rapid development due to introduction of capital assets for manufacturing of goods, introduction of new financial institutions, educational development for males and females, new government and banking schemes to access loan for the development of entrepreneurship activities and many more which help to developed economy. Females progressively access to education and job due to efforts taken by social reformers for their development, many financial institutions, government initiatives provided finance backup and mentoring & counseling through conferences and discussions definitely worth it to step up as a entrepreneur and given contribution to the nation's GDP. Today females have contributed and taken part and initiatives to developed nation's growth through their work in the field of Science, technology, entrepreneurship, and professional services. Now days, families taken more initiatives to provide education to their girl child which was hardly practiced in pre-independence period. Parents provide higher education to their girl child with moral support and guidance which help them to achieve the success in their career. Education is the only way which make us to take up right decisions provide right decision to take major and ethical step to shape our career in an effective and successful manner. Many women have shape up their career through the proper use of their skills, qualification, knowledge, potential and confidence in every field. If we talk about the entrepreneurship, the successful female entrepreneurs like Upasana Taku – Co-founder (Mobiwik), Divya Gokulnath – Co-founder (BYJU'S), Falguni Nayar – founder and CEO (Nykaa), Vandana Luthra – Founder (VLCC- Group), Supriya Paul – Founder (Josh-Talks), Vineeta Singh – Co-Founder (Sugar Cosmetics), Sabina Chopra – Founder (Yatra Online) and many more who are contributing to the Economic Growth and Development. Females have changed the stereotype mentality of the society through their work and contribution towards the nation's growth and development, Society development etc. if we talk about the jobs; females have secured the positions in each and every level of management and equally contributing towards the growth and success of organization in an efficient manner. Executive to manager level and even top position like CEO, managing director etc also acquired through their efforts, skills and knowledge optimization in a well manner.

## **2. OBJECTIVES OF THE STUDY**

To study the opinion and choice of female teenagers towards entrepreneurship in Kalyan and Dombivali Region.

To analysis the female teenager's decision regarding taking up the career in job or entrepreneurship.

To study the supporting aspects from the families towards girl child in respect of practicing entrepreneurship activities.

### 3. SCOPE OF THE STUDY

- The research states some important concepts like the practice of self-reliance, self-development, support, opportunities etc. which deals with the sustainability for everyone irrespective of caste, creed, customs and gender.
- For shaping up a successful career in an ethical and legal manner, moral support, family support, influence and motivation playing a vital and prominent role for everyone who wants to do something for them and become successful in their professional life.
- This study puts a limelight on the gesture of female teenagers who take up the decisions related to entrepreneurship or job to become successful person in their life.

### 4. HYPOTHESIS OF THE STUDY

1. H0:- Female teenagers do not choose job opportunities over entrepreneurship.  
H1:- Female teenagers choose job opportunities over entrepreneurship.
2. H0:- Families does not support their girl child financially towards entrepreneurship practices.  
H1:- Families support their girl child financially towards entrepreneurship practices.
3. H0:- Female child does not get more preferences and permission regarding the selection of career as a job or entrepreneurship.  
H1:- Female child gets more preferences and permission regarding the selection of career as a job or entrepreneurship.

### 5. RESEARCH METHODOLOGY

- **Type of Research:** - Descriptive research
- **Sample size:** - 94.
- **Target group:** - female teenagers.
- **Age group:** - 16-18, 18-20, 20-22.
- **Sampling methods:** - Cluster sampling method.

(40 female teenager selected from Kalyan Region and 54 teenagers selected from Dombivli region)

### 6. LIMITATIONS OF THE STUDY

- As this study discuss on the approach of female teenagers towards entrepreneurship or job which were situated in Kalyan and Dombivli region which does not apply their opinion and perception towards other which are living in other parts of region whether in Maharashtra or nationwide and even world-wide.
- As the data is taken from 94 female teenagers only due to time constraint.
- The age group which is considered for this study is 16 – 22 only. The adult female groups and beyond that were not taken in to the consideration.



## 7. REVIEW OF LITERATURE

**Dr. Anita Tripathy Lal – FORE School of Management, New Delhi, India,** highlighted in her research about the status of women entrepreneurs during the pre-independence period and post-independence period.

In her research she was taken the responses from 96 women who were well educated.

40 percent of the women have started their own startups and remaining women deals in jobs aspects in sectors like information technology, real estate agencies and multi-national corporations.

**Dr. Kalpana Koneru, Vignan’s University, Vadlamudi, Guntur Dt.,** stated in her research paper titled “WOMEN ENTREPRENEURSHIP IN INDIA-PROBLEMS AND PROSPECTS” that continuous motivation and inspiration help to influence women to involve in entrepreneurship activity.

Entrepreneurship awareness program should be promoted on mass scale.

Training, personality development programme boost the confidence of women to participate in entrepreneur activities.

Seminars, exhibitions, conference developed the interaction of women with the experts which help them to get information and knowledge build up and help to participate in entrepreneurship activities.

**Khayru, Nichen, Arnadi, Safarduddin, Tahir – 2021 (Indonesia)** stated in their research paper “entrepreneurship is an important aspect for the development of community. Due to entrepreneurship, people do not depend on jobs thus it will create more jobs for the society and dilute the problem of poverty and unemployment.

Entrepreneurship try to solve people’s financial problems and help to generate income for them. Researcher targeted the adolescents to collect the data regarding the social support towards entrepreneurship.

In their research they highlighted that to become an entrepreneur, social support will be an important part for the successful execution of entrepreneurship.

The researchers suggested that there is a linear relationship between entrepreneurship and social support.

Adolescents have the higher interest on entrepreneurship. Friends and peer group also plays a very important role which influence adolescents group to become entrepreneur.

Attending training programmers and workshop related to entrepreneurship which leads to educate about the aspect of entrepreneurship in a efficient manner.

**Bressler, Campbell, Elliott – Oklahoma state university,** stated in their Research paper titled “The Reverse Family Business – an emerging trend in entrepreneurship” conveys in their research that according to survey of business owner (SBO) 2007, approximately 27.9 million small business, 52 percent join their family business.

Most of the individuals join their family business rather than discovering other business idea.

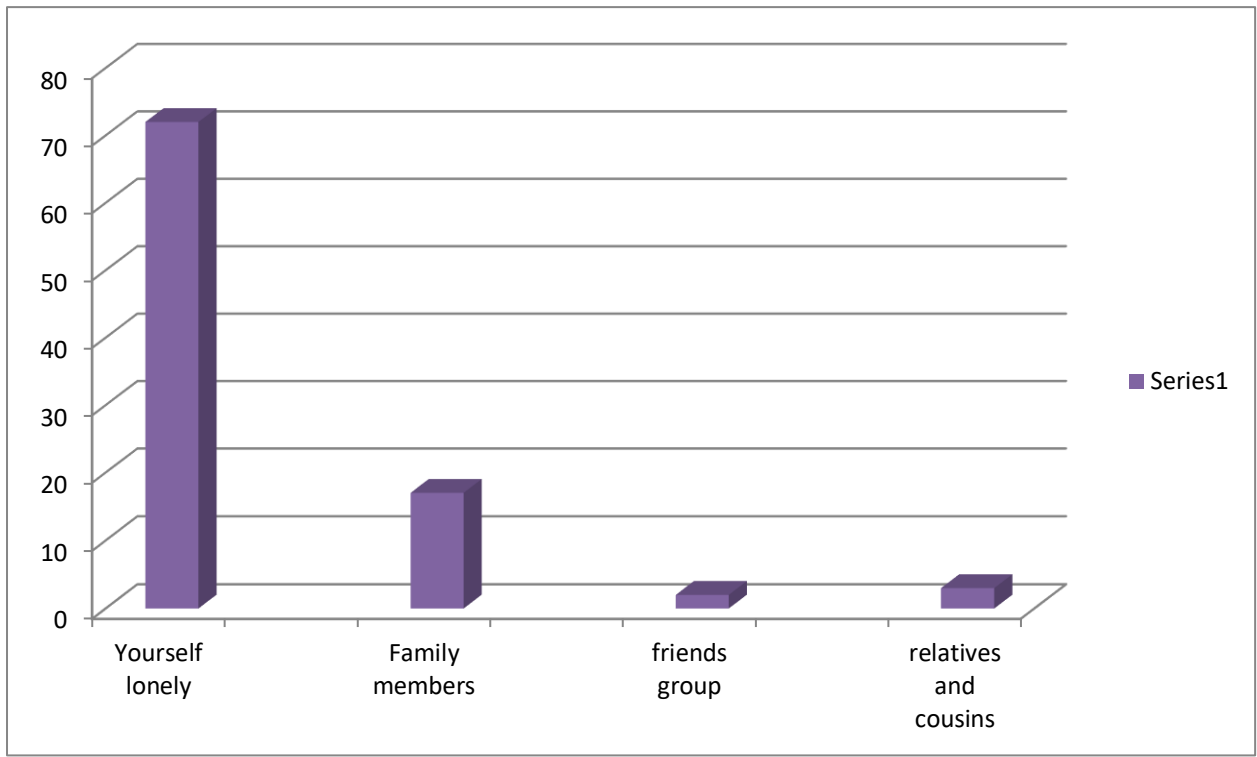
Developing or establishing new business is a big challenge. Rather than facing the new challenges they join their family business.

Now days, teenagers use social media platforms like Facebook rather than linked.in to promote their business.

## 8. DATA ANALYSIS AND INTERPRETATIONS

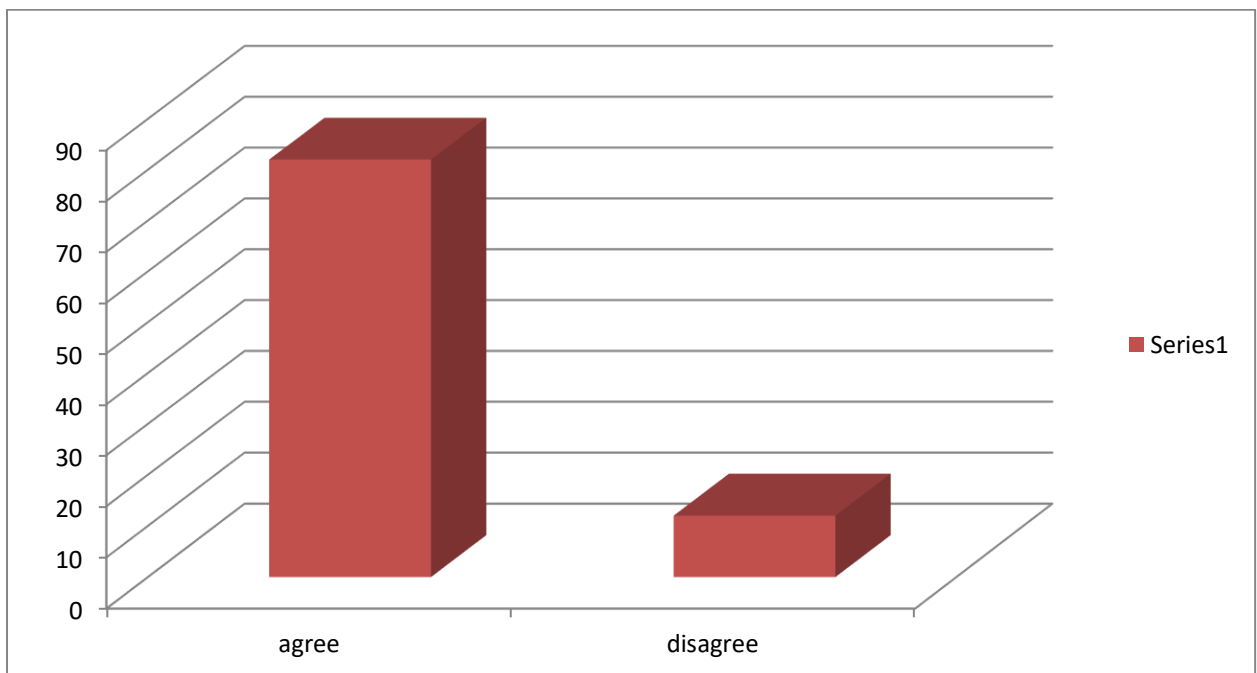
**Q.1. Your career decision was taken by....?**

**Answer:** Yourself: - 72 Family members: - 17 friends group: -2 relatives and cousins: - 3



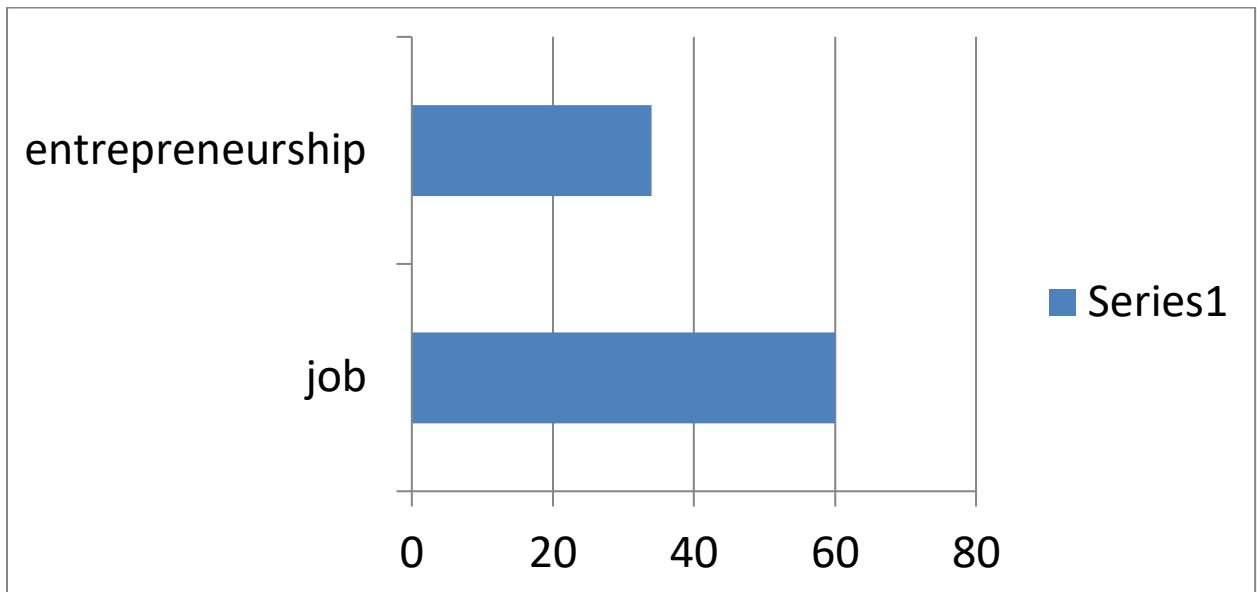
**Q.2. If your career decision was taken by your family, are you happy and agree with their decisions.?**

**Answer:** - agree: - 82. disagree 12



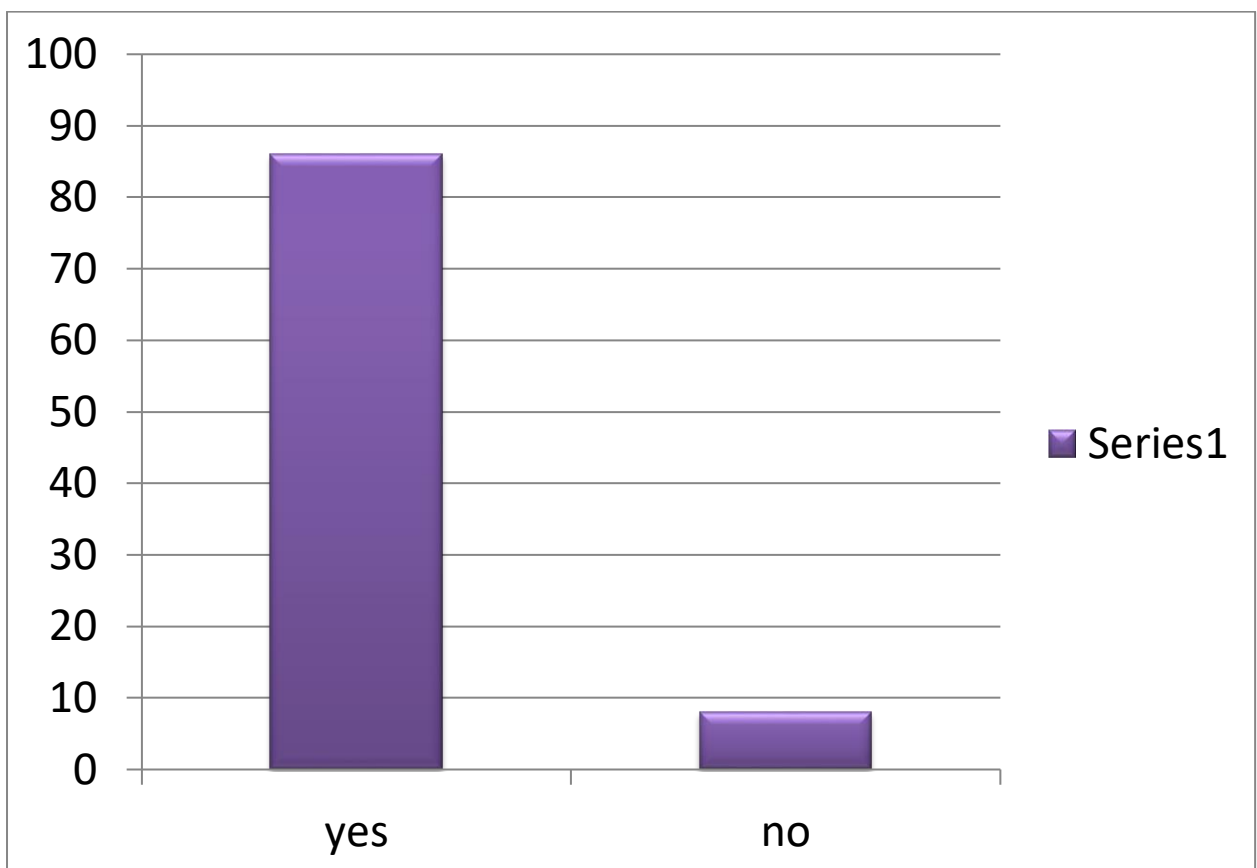
**Q.3. After completing your education, what will be your career goals?**

**Answer: - job: - 60 entrepreneurship: - 34**



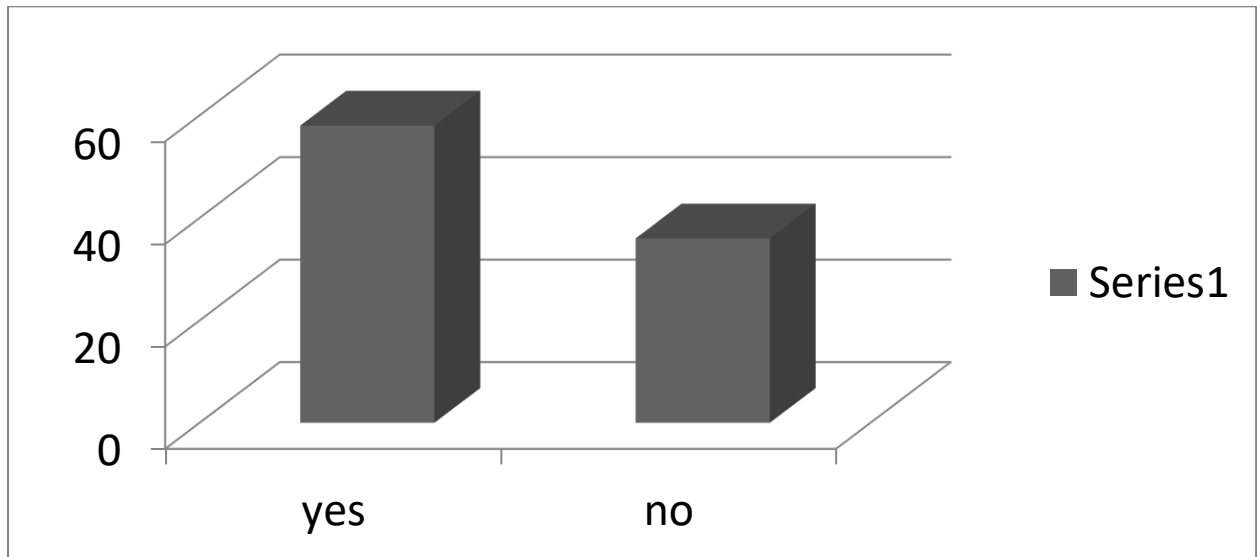
**Q.4. If you choose entrepreneurship, do you feel that your parents will agree with your decisions.?**

**Answer - Yes: - 86 No: - 8**



**Q.5. Do you feel that in today's scenario male child still get more preference and permission as compare girl child in terms of selecting job or entrepreneurship?**

**Answer:- Yes:- 58 No:- 36**



**Testing of hypothesis**

H0: - Female teenagers does not chooses job opportunities over entrepreneurship.

H1:- Female teenagers chooses job opportunities over entrepreneurship.

**The significance level is .050.**

- The categories defined by after completing your education, what will be your career goals = Job and Entrepreneurship/ business-women occur with probabilities .500 and .500.
- One-Sample Binomial Test was conducted to test the hypothesis 1.
- Significant value = 0.003 which is less than 0.05 which states that we reject null hypothesis and accept alternative hypothesis that defines female’s teenagers chooses job opportunities over Entrepreneurship.

H0:- Families does not support their girl child financially towards entrepreneurship practices.

H1:- Families support their girl child financially towards entrepreneurship practices.

**One-Sample Binomial Test Summary**

- Total N:- 94
- Test Statistic:- 85.000
- Standard Error:- 4.848
- Standardized Test Statistic:- 7.736

**Asymptotic Sig.(2-sided test) :- <.001**

The significant value is 0.01 which is less than 0.05 which states that we reject null hypothesis and accept alternative hypothesis that determines families support their girl child financially towards entrepreneurship practices.

H0:- Female child does not get more preferences and permission regarding the selection of career as a job or entrepreneurship.

H1:- Female child gets more preferences and permission regarding the selection of career as a job or entrepreneurship.

Do you feel that in today's scenario male child still get more preference and permission as compare girl child in terms of selecting job or entrepreneurship?

- No 36 38.3%
- Yes 58 61.7%
- Valid 94 100.0%
- Missing 0
- Total 94

**Goodness-of-Fit – Chi-square test.**

	Chi-Square	df	Sig.
• Pearson	.187	1	.665
• Deviance	.194	1	.659

- Significant level is 0.05.
- Chi-square test was conducted to test the hypothesis -3, which shows that the significant value is 0.665 which is greater than 0.05 but less than 1 which denotes that Female child does not get more preferences and permission regarding the selection of career as a job or entrepreneurship. As the data is collected from less samples which does not rely on universe opinion So we reject null hypothesis and accept the alternative hypothesis.

**9. FINDINGS OF THE STUDY**

- Female teenager’s career decisions were also taken by relatives, cousins, peer groups etc.
- Definitely most of the female teenagers are happy with the career decisions taken by their family members.
- Most of the female teenagers choose job opportunities as compare to entrepreneurship.

- Most of the female teenagers confidently convey that if they practice entrepreneurship, their family members will support them financially.
- Still many female teenagers also convey that, male child gets more preference and permission to choose their career as compare to female child.

## **10 CONCLUSION**

Each and every child is special whether it is a boy or a girl. Many parts of the society, few pupils make the discrimination between their children on the basis of gender which should be wipe out through trusting their child's capabilities, influence and motivation to be provided with moral and financial support definitely the female child also showcase their talent and make their parent's proud and create their own extra-ordinary identity and goodwill by which parents are expecting from the male child which is a irrelevant aspect in my view.

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# A Study on Awareness regarding Digital Rupee in Mumbai

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## ABSTRACT

The concept of a Digital Rupee has been gaining attention in India as the country explores the possibility of issuing its own digital currency. The Digital Rupee is seen as a way to provide a more efficient, secure, and inclusive financial system, especially for those who are currently excluded from traditional banking facilities. Research on the Digital Rupee is focused on understanding its potential benefits and challenges, including security, privacy, and regulatory issues. The data for this study was collected from 100 respondents by an online survey using a questionnaire. The research was undertaken to find out awareness level of people regarding digital rupee. The Reserve Bank of India has set up a panel to study the feasibility of issuing a Digital Rupee and to evaluate the risks and benefits associated with this concept.

**Keywords:** *Digital Rupee, Awareness, Benefits*

## 1. INTRODUCTION

The Digital Rupee (e), also known as the eINR or E-Rupee, is a tokenized digital representation of the Indian Rupee that will be released as a central bank digital currency by the Reserve Bank of India (RBI) (CBDC). A high reliability committee (IMC) was created in 2017 under the Department of Economic Affairs in the Ministry of Finance (MoF) to advise on the administration and use of virtual currencies in India, and it advocated a digital version of fiat money based on Distributed Ledger Technology (DLT). Despite the lack of regulatory recognition for cryptocurrencies, the RBI began preparing for future CBDC growth. On December 16, 2020, the RBI declared a regulatory sandbox to test next-generation cross-border payment technologies in order to acquire field test data and proof of advantages and hazards to the financial ecosystem. On January 29, 2021, the Indian government proposed a bill to prohibit cryptocurrency trading and investments while granting the RBI legal authority to develop a CBDC, dubbed the "programmable digital rupee," based on the knowledge attained from ability to handle Unified Payments Interface (UPI), Immediate Payment Service (IMPS), and Real-time Gross Settlement (RTGS) for distribution and validation purposes.

The launch will take place in two stages. The digital rupee has been released for wholesale transactions, i.e. big transactions, in the first trial phase. The RBI will follow up on the wholesale e-rupee pilot with a comparable retail trial later.

The first nation to introduce CBDC, which covered the whole country, was The Bahamas. Following a successful 2019 trial on the island agglomeration of Exuma, the Central Bank of the Bahamas released the Sand Dollar in October 2020. According to CBDC Tracker, the SandDollar's key aims were to reform and simplify their country's financial system, reduce service delivery costs, promote transactional efficiency, and enhance market inclusion.

Nigeria established a CBDC, eNaira, in October 2021, becoming the first nation in Africa and the second nation overall. The eNaira may be stored in a digital wallet and used for both in-store payments and money transfers. It like coins or cash, is a CBN liability. It is built on the same Blockchain as Bitcoin and Ethereum. However, there are significant distinctions. According to an IMF assessment, the eNaira has strong central bank access rights controls and, unlike crypto-assets, is not a financial asset in and of itself but a digital representation of a national currency that takes its value from the actual naira.

The Bank of Russia stated in February 2022 that early testing of the CBDC, commonly known as the "Digital Ruble," had been completed. The Bank of Russia intends to launch the digital ruble in the next years. According to Russia's most recent monetary policy update, the government will begin connecting all banks and lending institutions to the digital ruble network in 2024.

According to the Atlantic Council, CBDC is a research compound in the United States. The Joe Biden government signed an Executive Order in March 2022 to foster responsible innovation in the sphere of digital assets. According to the US Fed, a CBDC would provide a type of digital money that is a direct obligation of the Fed, securely bootstrapped to the US currency and government.

Iran's central bank said on September 22 that it intends to begin a prototype "digital rail" initiative in the following days. According to an official press release from the Central Bank of Iran (CBI), the goal of adopting the crypto rail is to convert banknotes into programmable entries. According to CBI, security is also a major consideration in the creation of the crypto trial.

The RBI thinks that by adopting the digital rupee, it would be able to address issues with current physical currencies and cross-border transactions. Cross-border money transfers and conversion into foreign currency is time-consuming and costly. With the introduction of the digital rupee, fast cross-border money transfers are expected to improve bank cash management and operations. Cash placement and monitoring are difficult in India. CBDC may tackle privacy and fix it in a non-threatening manner, hence reducing the desire for cash. The government will save money on operations, printing, distribution, and storage, advancing the government's objective of a cashless economy.

## **2. REVIEW OF LITERATURE**

According to Shreya Handa (2020): In India, digital payments have reached an all-time high in the last three quarters, and there is an unparalleled aversion to the usage of cash in general. Many people assume that currency should be as simple to transfer as email. A rising number of publications question whether the present financial system, and even banks, have now become outmoded. It demonstrates new form of payment system which will help in defining proper usage and track of money spend. Sure, the use of digital currency, such as a digital rupee, can potentially solve many problems in the Indian economy. One of the key advantages is that it allows for better tracking and monitoring of transactions, which can reduce tax evasion and counterfeiting. It also creates a clear and traceable record of transactions which can aid in combatting money laundering. Additionally, advanced analytics such as machine learning and big data can be used by regulators and government authorities to detect and prevent fraud and other illegal activities. This can lead to more efficient regulation and a more secure financial system. The findings reveal that the Reserve Bank of India (RBI) has been exploring the potential of implementing a Central Bank Digital Currency (CBDC) and utilizing Distributed Ledger Technology (DLT) to enhance the current financial system in India. This shows that India is interested in adopting new technologies to improve its financial systems and payment landscape.



However, it's also important to consider that the adoption of digital currency could present challenges.

According to D Priyadarshini & Sabyasachi Kar(2022), the introduction of Central Bank Digital Currencies (CBDCs) as legal tender by various central banks, including the Reserve Bank of India (RBI), raises important considerations such as the potential effects on monetary and national sovereignty, and development. In the context of India, where digitalization is rapidly growing, it is crucial for the RBI to address potential risks, establish appropriate infrastructure and regulations, and collaborate with other countries to successfully implement a CBDC.

According to Bibhu Dash et.al (2022), smart banking, which is the use of technology such as AI and ML, has greatly enhanced the efficiency, security, and cost-effectiveness of the financial sector. The rise in unstructured data from sources like social media and online banking has also provided financial institutions with valuable insights for customer analytics. It also highlights the socioeconomic and technical challenges that policymakers must consider when changing monetary policies. Furthermore, the paper discusses how 5G technology can enhance peer-to-peer transactions and open up new market opportunities through the automation of various use cases with blockchain. The findings of the study The adoption of smart banking in India has the potential to bring many benefits, however, it is crucial for the government to have a comprehensive plan in place for digital governance and risk management before moving forward.

According to Pawan Kalyani (2016), CBDCs, Central Bank Digital Currencies, have gained importance in the debate of economy digitalization, including the fast changes in the payments realm and the transformation of the concept of money. They are perceived as the next phase in the evolutionary journey of fiat money, from shells and cowries, to coins and paper money, and now to digital forms of fiat currencies. When discussing the implementation of CBDCs, there are several important considerations, including issues related to monetary sovereignty, national sovereignty, and developmental impact. It specifically examines the growing trend of paperless e-currency transactions worldwide and in the Indian market, where many services and products are available online and accept online payments. However, it is not clear how many people are actually using these methods to make payments. This study gives light on if the digital rupee is not adopted by a sufficient number of users, it will not only compromise the objectives of its creation, but also call into question the rationale behind using public resources to launch a CBDC. Furthermore, it can also pose a reputational risk for the central bank. Also,

this institutional transformation in India has a long road ahead of it, and we need to assure that it adds to rather than destabilizes our development process.

According to Barry Eichengreen et.al.(2022), there are various perspective regarding introduction of digital rupee in India. Transactions using a CBDC may also be less expensive than using credit or debit cards, as the bank would not be providing and charging for additional services such as fraud protection, overdraft protection, and credit lines. Additionally, transactions using a CBDC may be less expensive than bank deposits or debits, as they would not go through the costly interbank payment system. The findings demonstrate that India should also consider the possibility of issuing a CBDC, as many other central banks and governments around the world are exploring the option. While India's interest in CBDCs may have come later compared to other countries, the timing of its pilot project announcement is in line with other nations, showing that it is taking the possibility of issuing a CBDC seriously. Furthermore, the study finds to make a well-informed decision, India should form expert groups to study and make recommendations on these factors and make their findings public, as is typical for other initiatives. The Indian government agencies can still gain valuable insights from the discussions and studies of CBDCs, even if India does not decide to issue its own. By putting in place the necessary regulations, they can learn more quickly about the technology and its potential uses, which will help them to make more informed decisions if they decide to move forward with a CBDC in the future.

### 3. OBJECTIVE OF STUDY & RESEARCH METHODOLOGY

The object of study is to find out the awareness level of people regarding digital rupee.

Type of Research: It is an example of descriptive research. The method incorporated is Survey.

Source of Data: Primary and secondary data form the base of research, with primary data acting as the solid foundation for the same.

Sample Size: Total 100 respondents are selected on convenience sampling basis. The study was based on response received from people staying in the Mumbai city.

Statistical Tools used: One sample Chi Square Test & Percentage Analysis. Level of Significance: Alpha = 0.05

Limitation of the study: The respondents reside in Mumbai. The results of this study need not necessarily apply to other similar studies.

### 4. ADVANTAGES OF DIGITAL RUPEE

**Mitigating Risks:** Many governments are considering issuing their own national cryptocurrency as a way to control the growth of digital money and reduce risks associated with private cryptocurrencies. According to the International Monetary Fund, this would provide greater oversight and regulation of the market. Additionally, it is important for cryptocurrency exchanges to provide clear and comprehensive information about the products and risks involved to customers before they make investments. This can help to mitigate potential risks and protect investors.

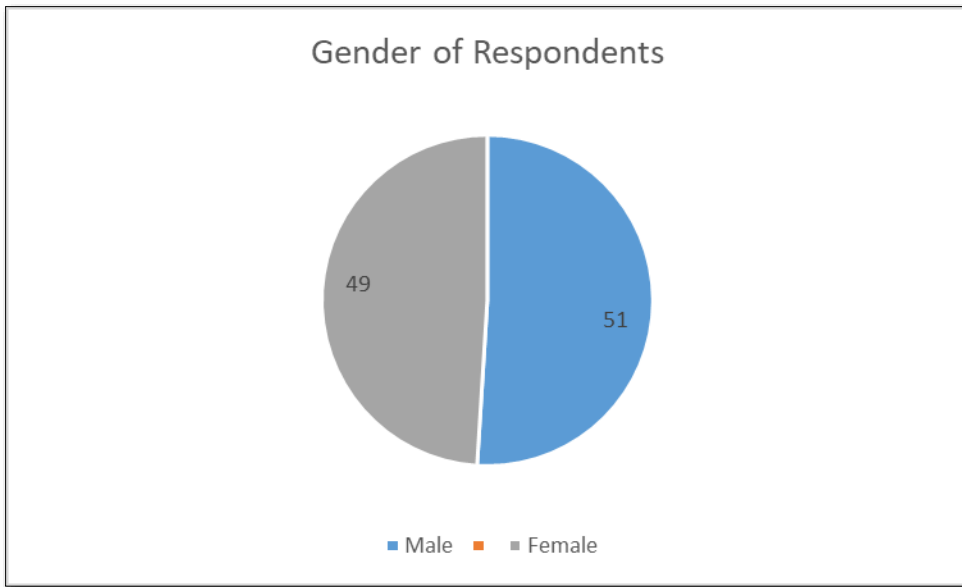
**Negative Interest Rates:** Negative interest rates are a monetary policy tool used by central banks to encourage spending and stimulate economic growth during difficult times. However, traditional bank deposit with negative interest rate may prompt people to withdraw their money and hold it in cash, which doesn't help the economy. Central Bank Digital Currencies (CBDCs) could be a solution for this, as they allow central banks to set a negative interest rate on digital wallets holding CBDCs, discouraging hoarding and promoting spending to aid economic activity.

**Encourages Cashless society:** The government's adoption of digital currencies can facilitate a shift towards a cashless society. This can have several benefits such as reducing tax fraud and making it easier for individuals to access financial services like remittances, loans, insurance, stocks, and smart contract-based financial products. However, it is important to ensure that necessary precautions are taken to safeguard individuals' privacy and financial data. Additionally, a cashless society can also lead to cost savings in printing and distributing physical currency and aid in tracking illegal activities like money laundering and terrorist financing.

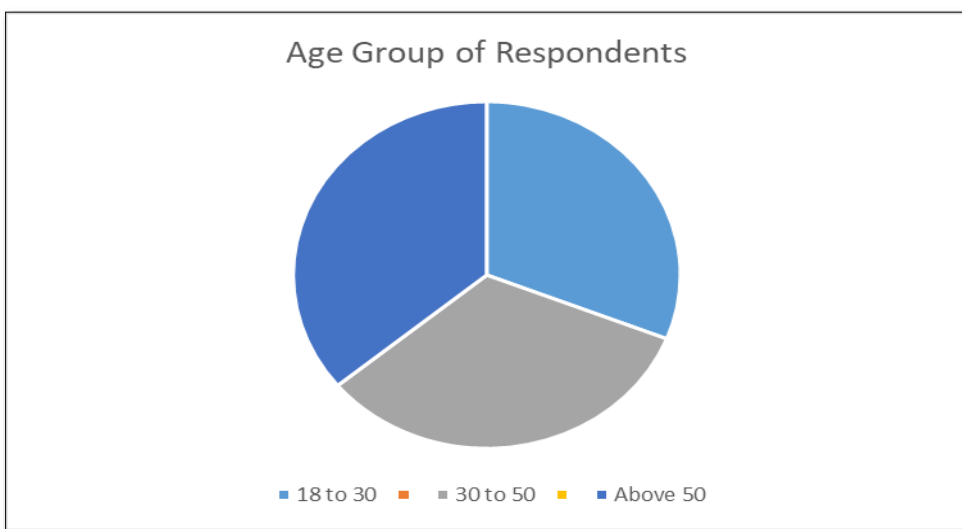
**Reduce volatility:** The Digital Rupee, as managed by the Reserve Bank of India (RBI), can offer a level of security and oversight that may not be present with other digital currencies, such as cryptocurrencies. This can reduce the risk of mishandling or illegal use of the currency.

### 5. DATA ANALYSIS & HYPOTHESIS TESTING

**Figure 1:** Gender of Respondents



**Figure 2 – Age of Respondents**



From Figure 1 & Figure 2, we see that out of 100 responses, 51 are received from male, the rest from female. The age group '18 to 30' received 31 responses, age group '30 to 50' received 33 responses and the age group 'Above 50' received 36 responses.

## 6. HYPOTHESIS OF STUDY

H<sub>0</sub>: Gender has no association with awareness regarding digital rupee. H<sub>1</sub>: Gender influences awareness regarding digital rupee.

Results of Chi Square Test

The chi-square statistic is 3.2413. The p-value is .071804. The result is not significant at  $p < .05$ . We therefore accept the null hypothesis and conclude that Gender has no association with awareness regarding digital rupee.

## 7. CONCLUSION

Digital rupee is promising owing to numerous benefits outlined above. However, to conclude, it is wise to point out certain drawbacks that digital rupee can face, in order to ensure complete and holistic understanding of the research problem. They are summarized below:

- **Lack of Privacy:** CBDCs or Central Bank Digital Currencies may require certain personal information for the purpose of identification and verification. This may include various forms of identification such as fingerprints, ID card, passport or others. Furthermore, the use of CBDCs can also create a digital record of transactions, which can include purchase made for goods and services like food, accommodation, and transportation, even when the device is not in use.
- **Danger to financial threat:** If the Reserve Bank of India (RBI) were to offer interest rates on digital rupee, it may lead to competition with the traditional banks. This could cause a decline in deposits for banks which can impact their ability to lend and provide other financial services. A decline in deposits can threaten the stability of the financial sector as banks rely on deposits as a source of funding.
- **Regulation and control of Government:** The Digital Rupee's association with government control can be a potential disadvantage, as it can interfere with the monetary policies and may have an impact on them. If CBDCs are seen as a substitute for traditional currency, it can weaken the central banks' power over inflation. Governments may have to adjust their macroeconomic policies in order to keep up with the competition, this could include incentives such as tax exemptions for those who use the digital rupee.
- **Potential cybersecurity threat:** The use of digital currencies brings up the concern of cybersecurity, particularly in a country like India where security threats are prevalent. The Mt Gox bankruptcy case, which was a digital currency exchange, is an example of the risks involved and has caused unease among investors who had their assets stored on the site. To protect users from cyber threats it's essential for the government, central bank and financial institutions to implement adequate security measures.

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# Finding Equilibrium: Balancing work and Family Commitments

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## **ABSTRACT**

This study explores the challenges faced by the individuals in maintaining a healthy equilibrium between their professional responsibilities and family obligations. In today's demanding world, achieving balance between work and family commitments has become an elusive yet crucial pursuit. The factors include the ever-increasing demands of modern workplaces, the evolving roles of employee's career and family domains, the effect of technological advancements and the prevailing societal expectations. Feelings of guilt, stress, and burnout often emerge as a result of trying to meet high expectations in both realms, leading to potential negative consequences on one's overall well-being. In response to these challenges, it highlights the importance of adopting effective strategies to foster work-life integration. These strategies may involve implementing flexible work arrangements, leveraging technology to enhance productivity, promoting family-friendly policies in organizations and fostering open communication between employers and employees.

**Keywords:** *equilibrium, work-life integration, work arrangements, leveraging technology and strategies.*

## **1. INTRODUCTION**

In the modern era, finding equilibrium in work and life commitments has emerged as a paramount challenge for individuals striving to lead fulfilling lives. The ever-increasing demands of the professional world, has intensified to strike a harmonious balance between career aspirations and the responsibilities of family. As societal norms and expectations continue to evolve, the roles of employee's in workplace and home, further influencing the dynamics of work-life integration. Understanding the implications of an imbalance is crucial, as it can have far-reaching effects on an individual's overall well-being, relationships and productivity. The psychological and emotional toll of attempting to meet the demands of both professional and domestic roles simultaneously cannot be understated. The burden of managing conflicting priorities often leads to feelings of guilt and stress create negative impact on individual's mental health and physical health in both spheres of life. Therefore, it becomes essential to uncover effective strategies and coping mechanisms that can aid in directing this challenging terrain.

By adopting open dialogue and collaboration among employers, employees and policymakers, we can strive to create environments that promote work-life integration and enable individuals to lead more satisfying and purposeful lives. By illuminating the path towards equilibrium, we hope to inspire individuals to embark on a journey of self-discovery and fulfilment, ultimately empowering them to create lives that harmoniously blend individual and work aspirations. The pursuit of equilibrium between work and family commitments is an ongoing and dynamic process that requires adaptability and resilience of one's priorities. By addressing the challenges head-on and implementing effective solutions, individuals can aspire to achieve a more fulfilling and well-rounded life that encompasses their fulfilment. It underscores the need for a collective effort from

individuals, employers and policymakers make a conducive environment that facilitates a healthier WLB.

## 2. REVIEW OF LITERATURE

**Khatun Samina, Saxena A.K (2019)**, they stated that the intricate association between job commitments and family life, aiming to reduce crucial interplay between the two domains. Maintaining a healthy work-life balance while receiving adequate family support has become an increasingly important aspect of modern living. A balanced work-life paradigm is essential for employee well-being, productivity, and overall life satisfaction. At the core of this equilibrium lies strong family support, which is crucial buffer against work-related stress and challenges. A harmonious work-life balance can positively influence family dynamics, leading to improved emotional well-being and strengthened familial relationships. The role of employers and organizations in promoting work-life balance initiatives, including family-friendly policies and programs

**Indu Gautam and Sameeksha Jain (2019)** they ascertained that the common challenges that hinder the attainment of WLB, like job-related stress and lack of flexible work arrangements due to technological advancements. It addresses the problems of employees in achieving a harmonious equilibrium between their individual life and professional commitments. The pursue hobbies, and prioritize self-care has become a pressing issue affecting individuals' overall well-being and productivity. The strategies for time management, setting boundaries and prioritization are discussed, empowering individuals to take charge of their schedules and make conscious choices that contribute to a healthier work-life integration.

**Padma S., Reddy Sudhir M., (2013)** they found that in today's progressive society, women play an increasingly significant role in the workforce. However, as women continue to pursue professional aspirations, the challenge of effectively balancing personal and work-life commitments becomes evident. By analyzing the unique challenges faced by women in maintaining work-life balance, the family support can positively impact their well-being and career success. The organizational need to implement policies that recognize and accommodate the diverse work-life needs of women employees, including parental leave, flexible work hours and remote work options.

**Abendroth Anja-Kristin, Dulk den Laura, (2011)** this study explores the importance of support systems in fostering work-life balance, examining various strategies, benefits and its effect on organizations and employees. The individuals strive to harmonize their personal and professional commitments. It identifies key elements of support, such as flexible work arrangements, access to childcare facilities, wellness programs and inclusive organizational policies that contribute to employees' ability to accomplish their responsibilities effectively.

**Ajith, M. & Patil, V. S. (2013)** they stated that the multifaceted aspects of WLB, aiming to provide a comprehensive understanding of its determinants, effects and coping strategies. In an era characterized by intense work demands and evolving family structures, help to achieve the balance between individual life and professional commitments.

**Chawla D & Sondhi N (2011)** they examined that the concept of WLB is increasing the today's fast-paced and competitive world. As more women in India enter the workforce, achieving a proper work-life balance becomes crucial for their overall well-being and productivity. Several key factors contributing to work-life balance issues among Indian women professionals, like inflexible work arrangements, lack of access to supportive workplace policies and societal pressure to prioritize family roles.

### **3. FINDING EQUILIBRIUM**

Involving family members in decision-making processes have been highlighted as key strategies to find equilibrium. Finding Equilibrium is essential to keep in mind that the field of work-life balance.

**Work-Life Conflict:** Balancing work and family commitments is a significant challenge for individuals. The conflict between professional demands and family responsibilities can lead to stress and negatively impact well-being.

**Importance of Work-Life Balance:** Research consistently highlights the importance of achieving work-life balance. Individuals who manage to strike a balance report higher levels of job satisfaction, better mental health and more fulfilling family relationships.

**Flexible Work Arrangements:** The flexible work arrangements, such as remote work and flexible hours, can positively affect work-life balance. These arrangements allow individuals to schedules and adjust their work commitments to accommodate family needs.

**Supportive Work Environment:** offers family-friendly policies can significantly contribute to employees' ability will help to balance family and work commitments.

**Communication and Planning:** Effective communication and planning of individuals is very difficult for achieving equilibrium. Regularly discussing work schedules, family events, and sharing responsibilities can help in managing both aspects of life.

**Individual Strategies:** Different individuals may adopt various strategies based on their unique circumstances and priorities. Some may prioritize certain aspects during specific period and use time management techniques or delegate tasks to find equilibrium.

#### **3.1 BALANCING WORK AND FAMILY COMMITMENTS**

In today's demanding world, finding WLB has become an ongoing challenge for many individuals. Juggling the responsibilities of a career while maintaining a fulfilling family life can lead to stress, burnout and strained relationships. Though, with proper strategies and mind-set shifts, achieving equilibrium between these two vital aspects of life is possible.

#### **3.2 THE IMPORTANCE OF WLB**

WLB is most important for overall well-being and satisfaction. Striking the right balance allows the employees more productive, focused and engaged in both their work and life. Neglecting one aspect in favour of the other will lead to negative consequences, affecting work performance and mental health. Achieving equilibrium is not about dividing time equally but rather creating harmony and alignment between the two areas.

#### **3.3 UNDERSTANDING INDIVIDUAL PRIORITIES**

The first step in finding equilibrium is understanding and prioritizing individual commitments. The self-awareness can help in crafting a balanced approach that aligns with one's values and long-term objectives.

#### **3.4 EFFECTIVE TIME MANAGEMENT**

Efficient time management is the backbone of achieving work-life balance. Creating a well-structured schedule that includes dedicated time for work tasks, family activities and personal pursuits can lead to increased productivity and reduced stress. Utilize time management like the time-blocking to stay focused and maximize productivity and have time for family and self-care.

### **3.5 EMBRACING FLEXIBILITY AND REMOTE WORK**

The remote work and flexible work arrangements has provided new opportunities for achieving work-life equilibrium. The possibility of remote work provides greater control over the schedule and reduce commuting time. Flexibility in work hours can also help accommodate family commitments without compromising professional responsibilities.

### **3.6 INVOLVING FAMILY IN DECISION-MAKING**

Balancing work and family commitments is a team effort. Involve the family in decision-making processes when possible. Discuss work schedules, commitments and any challenges that may arise, encouraging open communication and understanding among family members. This involvement fosters a supportive environment that eases the burden of balancing responsibilities

## **4. THE BENEFITS OF FINDING EQUILIBRIUM**

Finding equilibrium between work and family commitments yields numerous benefits for individuals and their families. Improved mental health, reduced stress levels, enhanced job satisfaction and stronger family bonds are just some of the positive outcomes of a well-balanced life. Moreover, individuals who achieve work-life balance are generally more resilient and better equipped to handle life's challenges.

## **5. FINDINGS**

- By proactively managing work and family responsibilities, will improve the mental health, reduced stress levels and enhanced job satisfaction.
- The positive impact extends beyond personal well-being, as it fosters stronger family bonds and resilience in facing life's challenges.
- Achieving work-life balance is not an unattainable goal, it is a realistic and achievable reality.
- By implementing the strategies, the individuals can strive towards a more fulfilling and harmonious life that develops both career aspirations and family well-being.
- Gender equality, flexible work policies and family-friendly practices will improve the work-life balance among the professionals.
- The role of education and awareness in empowering women to negotiate for better work-life balance and challenge traditional gender norms.

## **6. CONCLUSION**

The employees require self-awareness, effective communication and intentional time management. By understanding personal priorities and setting boundaries, individuals fulfilling the harmonious life that supports both career aspirations and family well-being. The WLB is not a dream but it is an achievable reality that enhances the quality of life. Achieving equilibrium among the job and family commitments is a dynamic and ongoing journey need dedication. The WLB lead to tremendous benefits for individuals and their families. Finding the right balance is not about dividing time equally between work and family, but rather about creating harmony and alignment that aligns with one's values and priorities. The family support mechanisms, such as spousal cooperation, involvement of extended family members and childcare assistance, act as critical enablers for women employees in managing their personal and work-life responsibilities.

The family culture is help to shared responsibilities positively impacts women's career growth



and job satisfaction. Implementing gender-sensitive practices that foster a more inclusive and enabling environment for women employees to thrive both personally and professionally. Embracing family support as a cornerstone the WLB lead to a more equitable, satisfied and resilient female workforce. The strategies and recommendations will enhance WLB such as promoting flexible work arrangements, implementing policies that support work-life integration, offering childcare facilities and fostering a supportive and inclusive work culture. Addressing the unique challenges faced by women in achieving work-life balance can lead to increased productivity, job satisfaction and well-being, benefiting the employees and the nation's workforce as a whole.

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# Monitoring The Real-Time Level of Liquefied Petroleum Gas in A Cylinder

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## ABSTRACT

This study presents a real-time LPG monitoring and alert system tailored for homes and restaurants, countering the drawbacks of manual monitoring. Gas sensors offer live gas supply data, and mobile alerts promptly notify users of critical levels. The user-friendly interface optimizes gas usage, bolsters safety, and fosters sustainability. Respondents' feedback underscores the system's potential to enhance safety through efficient refill planning and early leak detection. Despite concerns about initial costs and technology disruptions, participants support the system's implementation. Recommendations encompass regular maintenance and tamper-proof sensors. This innovation marks a pivotal step towards safer and more efficient LPG management, promising a substantial impact on residential and commercial sectors alike.

**Keywords:** *Liquefied Petroleum Gas, Gas Level Monitoring, Mobile Alert System, Gas Leak Detection*

## 1. INTRODUCTION

The increasing use of Liquefied Petroleum Gas (LPG) as a prominent energy source in residential homes and restaurants has brought about safety and management challenges, particularly concerning the potential risks of gas leaks and shortages (Mensah, 2023). Traditional manual methods of monitoring LPG levels and detecting leaks have proven to be inefficient and often lead to delayed identification of hazards, resulting in an escalation of accident risks (Khan, 2020). To address these limitations and enhance the safety and management of LPG usage, the current project proposes the development of an innovative Internet of Things (IoT) based system for real-time monitoring of LPG levels and timely mobile alerts (Economy, 2022). It is crucial to ensure accurate and effective monitoring and management of LPG levels, especially considering the increasing adoption of LPG as a cleaner fuel source in regions like Ghana, where the Ministry of Energy has actively encouraged its use to reduce reliance on traditional fuels (WLPGA & GLPGP, 2019). Therefore, the successful implementation of this project is of paramount importance to foster a safer and more sustainable environment for LPG utilization (Mensah, 2023).

The traditional method of manually weighing LPG cylinders for monitoring purposes has proven to be inefficient and wasteful, as it may lead to the unnecessary release of gas into the atmosphere during measurements (Zakaria et al., 2017). In contrast, the proposed IoT-based system offers a technologically advanced and environmentally friendly alternative, enabling users to remotely and accurately monitor LPG levels in real-time, without the need for manual intervention or gas wastage (Economy, 2022). This real-time data empowers users to proactively plan gas refills, thereby preventing shortages or leaks and enhancing overall safety. The mobile alert feature is a

critical component of the system, providing users with timely notifications on their smartphones or other devices, even when they are away from the location. This capability ensures that users stay informed about their gas levels at all times, promoting effective management and preventing potential accidents (Economy, 2022).

Enabling remote and accurate monitoring, proactive gas supply management, and timely notifications, this project seeks to enhance safety, optimize gas usage, prevent accidents, and promote sustainability in LPG utilization (Economy, 2022). The development and successful implementation of this innovative system have the potential to foster a culture of efficacy and environmental consciousness in the way LPG is utilized, contributing to a safer and greener environment (Mensah, 2023).

## **2. LITERATURE REVIEW**

This section gives a summary of the relevant literature.

### **2.1 RELATED LITERATURE**

The literature review explores existing research and projects related to monitoring and detecting gas leakage in LPG cylinders. Al Abdullah and Hussein (2021) proposed a smart home safety system for monitoring LPG concentration in the kitchen and providing alerts when gas levels reach a threshold. However, it lacks a mobile alert system and smart actions to eliminate gas leakage. In contrast, this study emphasizes a mobile alert system and proactive smart actions to enhance safety and efficiency in gas monitoring. Potdukhe and Gawai (2013) introduced a microcontroller-based system for LPG leak detection using the MQ6 gas sensor. It triggers alarms and alerts individuals via cellular networks when detecting LPG leakage. However, it lacks continuous monitoring and real-time gas level updates, which this study focuses on. It also lacks a mobile alert system, a key feature of this project for enhancing remote monitoring and response. Juvanna et al. (2014) proposed a system addressing the need to detect LPG cylinder weight decrease, notifying users when gas is running out. However, it relies solely on weight decrease rather than real-time monitoring and lacks a mobile alert feature that this study aims to incorporate.

Zakaria et al. (2017) introduced a non-invasive ultrasonic instrumentation system offering real-time LPG level data. However, it focuses only on one-cylinder size, while this project aims for a versatile solution usable with various cylinder sizes. The ultrasonic system may also require precise sensor positioning, making it less user-friendly than the comprehensive mobile alert system included in this project. Muthuvinayagam et al. (2014) developed a gas leakage detection system that activates an alarm when concentrations exceed normal levels. However, it lacks continuous gas level monitoring, unlike this study that aims for real-time tracking and mobile alerts for comprehensive LPG monitoring. This study by Jebaraj et al., (2023), highlights the significance of Liquefied Petroleum Gas (LPG) in everyday life and its various applications. To address safety concerns related to gas leakage, the researchers have developed a system that automatically detects leaks and alerts users through an LCD display. Additional safety features like automatic electricity cut-off and exit door opening are included. The system also monitors room temperature, and all status parameters are conveniently displayed on the LCD. Despite its benefits, the study acknowledges limitations, such as gas sensor accuracy and GSM network coverage issues. Addressing these limitations will enhance the system's efficiency and ensure safe LPG usage.

The creation of a Smart LPG Monitoring and Automatic Booking System based on IoT is discussed to address typical LPG use concerns. These concerns include gas cylinders running out of gas at inopportune times, a lack of information about gas levels, and the inability to estimate the cylinder's working days. The suggested Smart Gas Kit makes use of IoT to continually measure and show the gasoline level of LPG cylinders, booking a new cylinder when necessary.

For weight measurement, the system utilizes a load cell interfaced with a microcontroller and transmits notifications to the user's mobile phone through Bluetooth module (Gupta et al., 2021). The study on IoT-based LPG monitoring systems shows a growing interest in enhancing user safety and convenience. The study identified challenges like lack of awareness about gas levels and timely refills. IoT technology offers real-time updates via mobile apps, accurate LPG level measurement, and predictive algorithms for refill needs. Safety features like gas leakage detection are emphasized. However, further research is needed on algorithm performance and mobile app security. Addressing these gaps will improve the system's efficiency and safety for LPG consumers (Arpit et al., 2019). Varma and Jayavel (2018) conducted a study on gas detectors' applications in various industries, categorizing them based on gas type and sensor technology. However, the effectiveness of the IoT-based gas leakage detection system for real-time LPG monitoring in cylinders may be influenced by factors like sensor accuracy, internet connectivity, and prompt response to alerts by authorities. Thorough testing and consideration of these factors are crucial to ensure reliable performance and user satisfaction.

Zhang Jiankun and Huang Lei's (2014) study presents an innovative gas sensor monitoring system using IoT technology. The system's strengths include low power consumption, cost-effectiveness, and high reliability. However, limitations include the lack of real-world performance data, insufficient security analysis, and comparison with other systems. Addressing these would enhance understanding of the system's capabilities and challenges. Nagib et al., (2020) proposed an IoT-based smart gas system using a sensor to measure and display cylinder content. It enables automatic booking via notifications. Limitations include potential inaccurate measurement due to sensor calibration, reliance on stable internet connectivity, and need for cooperation from distributors and consumers. It does not address security and privacy concerns. However, it provides insights into IoT for gas management and automated monitoring. Despite offering gas leakage and fire detection solutions, Sony et al., (2019)'s IoT-based system has limitations. Effectiveness relies on sensor accuracy and reliability. SMS and call notifications rely on stable internet connection. Successful implementation requires user and agency cooperation to embrace IoT. Considering these limitations is crucial to optimize functionality and ensure efficiency.

## **2.2 THEORETICAL FRAMEWORK**

The study adopted the Internet of Things (IoT) framework, which seeks to effectively implement real-time monitoring of LPG levels using gas sensors, understanding the communication protocols and data flow involved in transmitting real-time data to the central monitoring system. This study analyzes the essential features required to develop a mobile alert system within the IoT network, ensuring timely notifications regarding critical gas level situations to users' smartphones or mobile devices. The IoT framework theory serves as a foundational framework for the study, guiding the design and development of a comprehensive gas monitoring system that enables users to make informed decisions, enhance safety, and efficiently manage their gas supply. Observers in the emerging digital landscape have recently experienced the widespread presence and influence of IoT-enabled devices. This technology has opened up fresh possibilities in the tech industry, while also presenting a range of challenges that demand heightened attention and consideration (Nord et al., 2019). Moreover, the Internet of Things (IoT) technology is at the core of the project's aim to provide real-time monitoring and mobile alerts, making it the most appropriate theory to guide the study's implementation and ensure successful development of the LPG gas level monitoring system.

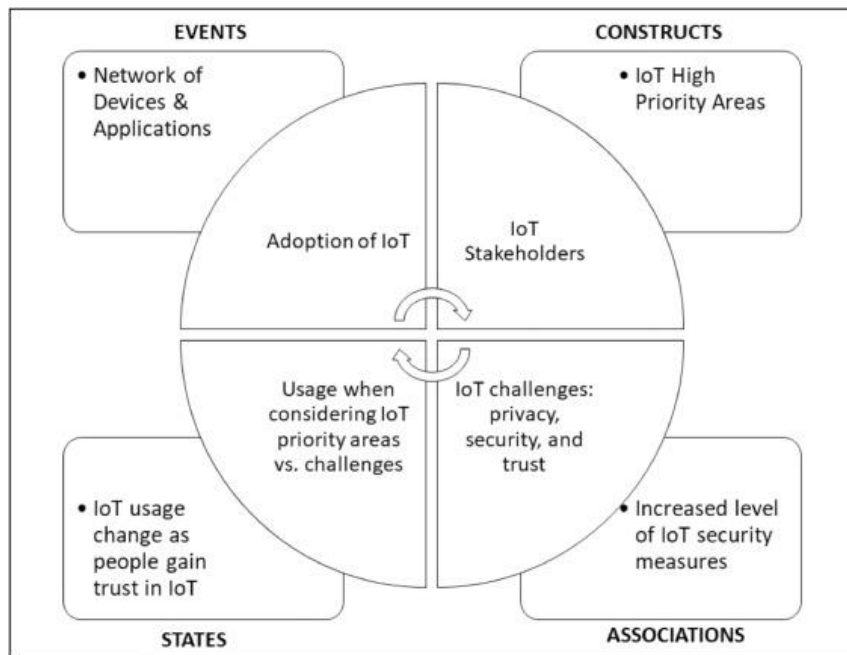


Fig. 1:

*IoT theoretical framework and conceptual model*

**Source: (Norda, 2019)**

The theoretical framework, depicted in Figure 1, consists of four key parts, which will be discussed in the following sections. In the lower-left section, the concept of "States" refers to the range of values that each construct in the theory might encompass. This includes the inside boundary state, denoted as "Usage," which explores the priority areas and challenges associated with the Internet of Things (IoT). Uncertainties, particularly concerning privacy and security, can influence usage, and users may be willing to take risks if the benefits are substantial. On the other hand, the outside boundary state encompasses "IoT usage change" as users gain trust in the IoT system, leading to potential usage increases that require further investigation (Forbes Insights Team, 2017).

### 2.2.1. DEFINITION OF CONSTRUCTS

The study adopts the Internet of Things (IoT) framework to achieve its objectives of optimizing gas usage, enhancing safety in LPG utilization, and implementing real-time monitoring using gas sensors. The framework encompasses various constructs: states, events, constructs, and associations. States involve identifying priority areas and challenges in IoT adoption specific to LPG gas monitoring, including real-time monitoring, data security, and user convenience. Events center around the adoption of IoT technologies in the gas monitoring system, integrating gas sensors, mobile alert systems, and data transmission protocols. Constructs represent individuals impacted by or interested in the IoT, such as end-users, homeowners, and regulatory authorities, whose perspectives are vital in system development. Associations focus on increased IoT security measures to safeguard sensitive data and ensure user safety. Leveraging the IoT framework and exploring these constructs, the study aims to design a comprehensive gas monitoring system that optimizes usage, enhances safety, and provides timely alerts to users, enabling efficient gas management (Weber, 2012).

### 3. RESEARCH METHODOLOGY

The study employed a qualitative research design and a purposive sampling technique to sample 10 respondents (8 females and 2 males). Data collection was conducted using interview guides, allowing for in-depth exploration of Respondents' perspectives, experiences, and opinions regarding LPG gas usage and safety measures. This systematic approach ensured that the study gathered relevant and valuable insights to address the research questions and objectives effectively. The data collection process spanned from July 2022 to December 2022, providing ample time to gather comprehensive data from the Respondents. Thematic analysis was employed to identify recurring themes and patterns in the Respondents' responses and observations of existing gas management practices. This analysis, along with a thorough review of relevant literature, ensured the comprehensive development of the real-time gas monitoring system.

### 4. RESULTS

The software development approach used in this study is the Rapid Application Development (RAD) methodology. RAD is a structured and iterative software development process which enabled the delivering of a working prototype, gather valuable user feedback, and make necessary adjustments along the way. By using qualitative methods and the Rapid Application Development (RAD) approach to efficiently design and develop a real-time gas level monitoring system. The RAD methodology consists of four stages: Requirements Gathering, User Design, Construction, and Cutover. The subsequent sections delved into a detailed analysis of each stage within the RAD model, illustrated in figure 2.

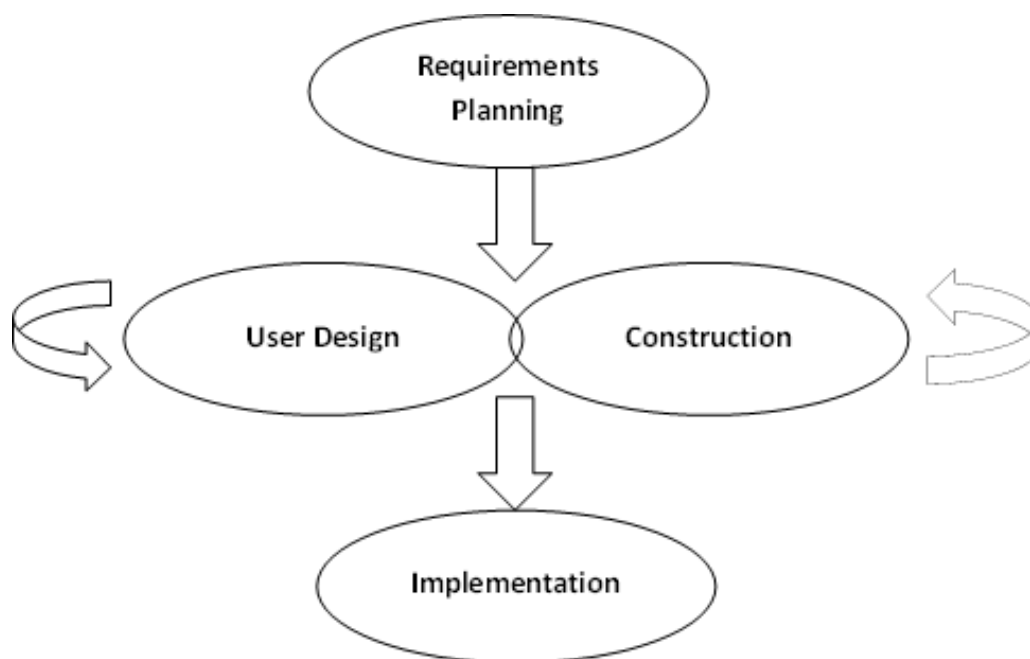


Figure Rapid

2

*Application Development Model*  
*Source: (Software Engineering, 2016)*

#### 4.1 REQUIREMENT PLANNING

The study chose a group of Respondents from various backgrounds, including students living in Pentecost University hostels, as well as households and eateries located in Sowutuom, within the Greater Accra Region of Ghana. These selected Respondents actively utilize LPG in cylinders, making them valuable contributors to the study's data collection process. The primary was utilized

for the study. Semi-structured interview guides were used to collect qualitative data from homeowners, students, and restaurant managers. The interviews were to explore their experiences with LPG usage, gas monitoring practices, and perspectives on essential features for a mobile alert system.

#### 4.1.1 INTERVIEW RESULT AND ANALYSIS

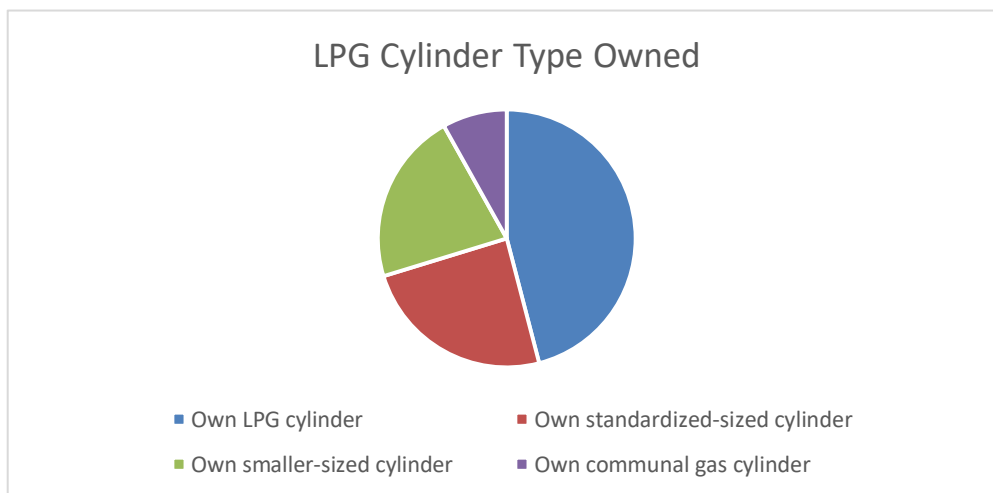


Figure 3. Representation of LPG Cylinder Owned by Respondents  
Source: (Field, 2022)

Respondents were asked about their ownership of gas cylinders and their sizes. The majority of respondents (85%) reported owning gas cylinders, with 45% having standard-sized cylinders (e.g., 14 kg) and 40% having smaller-sized cylinders (e.g., 6 kg). Respondents highlighted several benefits of using LPG compared to traditional means of cooking and heating. The primary advantages reported were cleaner combustion, reduced pollution, faster cooking, convenience, and cost-effectiveness. When discussing the proposed LPG monitoring system, respondents expressed optimism about its potential positive impact through real-time monitoring to efficiently plan refills and enhance safety by early leak detection. However, concerns were raised regarding initial costs for low-income households and potential technology disruptions. Certain Respondents expressed concerns about their limited technological proficiency, underscoring the need for intuitive, user-friendly interfaces.

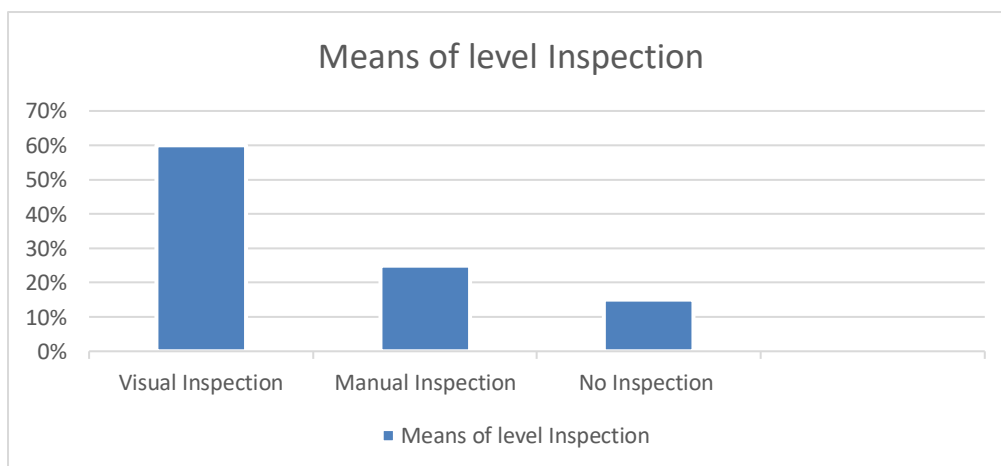


Figure 4. Representation of Means of Level Inspection  
Source: (Field, 2022)

Most Respondents (60%) relied on visual inspection to gauge gas levels, while 25% used manual

indicators, but acknowledged these methods' unreliability. Recommendations included regular maintenance, accurate level data, and durable tamper-proof sensors to optimize usage and ensure reliability. Respondents expressed interest in the proposed monitoring system for more reliable gas level information. Incorporating mobile applications for notifications and remote monitoring was suggested.

### 4.1.2 USER DESIGN

The User Design phase visualized the system's framework using UMLs like Use Case, Data Flow, and Context Diagrams. These structurally portrayed system aspects aligning with user requirements. Design objectives and architecture were outlined to guide development. The database structure was defined through an Entity-Relationship Diagram elucidating table relationships, streamlining data storage and retrieval. Prototype interfaces were refined based on usability feedback to ensure user-friendliness. This iterative visualization and refinement bridged the concept-execution gap. The stage precisely outlined structural aspects and database relationships to guide development towards the user requirements.

### 4.1.3 CONSTRUCTION PHASE

During the construction, task of transforming prototypes into a fully functional working model. The team delved into the creation of programs and applications, followed by the coding phase where the logical blueprints were translated into executable code. The valuable insights of respondents played a vital role and preparation for swift construction, the development of programs and applications, the coding process, and comprehensive testing procedures encompassing unit, integration, and system levels. Tools and techniques were employed to bring the proposed system to life in alignment with the study's objectives. Visual Studio, equipped with its Visual Basic component, played a pivotal role in this process. It was used to design the Graphical User Interfaces (GUIs) of the system and to write the necessary codes. This tool facilitated the development of a user-friendly interface and the implementation of essential functionalities.

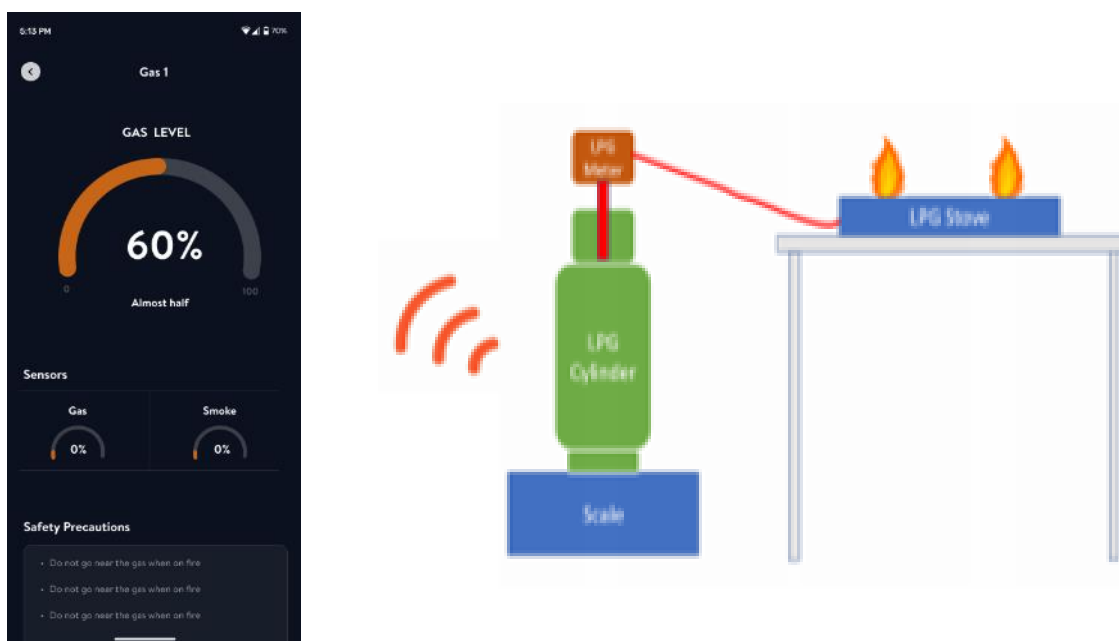


Fig. 6. Real-time LPG cylinder monitoring system: Scenario

### 4.1.4 CUTOVER PHASE



The real-time LPG monitoring system was deployed in households and restaurants to evaluate practical performance (Leung et al., 1997). User training ensured effective adoption and utilization. Continuous monitoring and feedback enabled addressing issues and enhancements for optimal performance, aligning with study objectives. System and user acceptance testing using the User Acceptance Testing method verified it met expected standards before deployment (Leung et al., 1997). Testing engaged participants like students and managers to evaluate usability and alignment with requirements, identifying discrepancies between system functionalities and user expectations. This ensured user-friendliness while providing insights to refine safety features and optimize gas use. The maintenance stage focuses on sustaining operational efficiency, performance, and effectiveness to ensure the system continues fulfilling real-time monitoring and timely notification objectives for safe LPG utilization.



**Fig. 6. Sensors**



**Fig. 7. Load cell sensor**



**Fig. 8. Arduino Uno R3**

#### **4.1.5 DESIGNING TOOLS**

The integrated tools enabled real-time LPG monitoring system development. Flutter and Dart crafted an intuitive app interface. Firebase enabled prompt alert data synchronization. Blynk Cloud facilitated hardware data acquisition. Arduino microcontroller with C programming-controlled sensor-app communication. Together, they enabled efficient real-time monitoring, synchronization, control, and alerts. The load cell, gas sensors, WiFi module, buzzer, and controller tracked LPG levels, detected leaks, transmitted data, and activated hazard alerts. Their synergistic integration enabled comprehensive real-time monitoring, connectivity, and automated safety features for efficient LPG management.

#### **5. CONCLUSION**

This study successfully realized its objectives by conceptualizing, developing, and implementing a real-time LPG gas level monitoring and mobile alert system tailored for both residential homes and restaurant environments. The study's findings emphasize the importance of user-friendly interfaces to accommodate varying technological proficiency and laid a foundation for the implementation of a safer and more sustainable LPG management system that will benefit an entire community. This study was another step toward home automation and reduced human intervention in monitoring the level of LPG in the gas cylinder, increasing the urgency in ordering a refill of the LPG cylinder. It was a dependable system, limiting the number of inconvenient scenarios of gas shortage in the middle of cooking. The system's potential for remote access and management opened avenues for commercialization, where the generated revenue was channeled back into refining the system and addressing any limitations it encountered. In essence, this initiative symbolized the fusion of home automation, practical utility, and innovative business prospects, poised to revolutionize LPG management practices within a well-defined context.

## 5.1 RECOMMENDATIONS

Continuous user training and feedback loops are crucial to ensure the LPG monitoring system remains user-friendly as proficiency varies. Partnerships with local LPG suppliers could streamline timely refills, enhancing practicality. Collaborating with manufacturers could enable sensor integration in new cylinders, expanding. Addressing power challenges through energy efficiency and alternative sources would improve sustainability. Comprehensive market research and targeted marketing strategies are needed to tap the system's commercial potential. Reinvesting profits into research and development would optimize the system. Overall, adhering to these recommendations can enhance user-friendliness, accessibility, and efficacy, contributing to a safer and more efficient approach to LPG management.

## 5.2 SUGGESTIONS FOR FUTURE STUDIES

Future research can enhance LPG management and home automation by incorporating automatic leak detection through advanced sensors and algorithms to promptly identify and mitigate hazards. Expanding the geographic scope by implementing the system in diverse regions could provide comprehensive insights on usability and effectiveness across contexts. Exploring partnerships with government and utility companies could enable widespread adoption. Investigating AI and machine learning to analyse patterns and optimize refill schedules could improve predictive capabilities. By refining safety features, broadening reach, and integrating cutting-edge technologies, future work can significantly advance LPG management practices, home automation, and integration of smart technologies, reshaping LPG utilization within a broader societal context.

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# Design and Optimization of an Intelligent Automated Water Tank Filling System for Sustainable Water Management

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## ABSTRACT

This paper designs an automated water tank filling system using technologies like microcontrollers, sensors, and solar power to enable smart water usage in Ghanaian communities. The system monitors water levels using ultrasonic sensors and automatically controls pumps via a microcontroller and solenoid valve to optimize filling and prevent overflows. Key components include the ESP32 microcontroller, LCD display, voltage regulator, and rechargeable batteries. The methodology follows the Rapid Application Development approach, incorporating requirements gathering, prototyping, and user feedback. Results demonstrate a reliable, energy-efficient system to reduce water wastage, enhance sustainability, and empower communities through optimized usage. The intelligent automation promotes precision in water resource management.

**Keywords:** *Automated water tank filling, Intelligent systems, Sustainability, Optimization*

## 1. INTRODUCTION

Water covers approximately 70% of the earth's surface and naturally exists in all three physical states, yet only 2.5% of the global water supply is freshwater (Mishra, 2023). Most freshwater is stored as deep groundwater, leaving a limited amount readily available for human use (Mishra, 2023). As water scarcity becomes a pressing issue worldwide, there is an urgent need to safeguard current water sources and develop strategies to ensure adequate and sustainable water supplies for present and future generations. Water is vital for life, so its availability directly and indirectly impacts human health, welfare, socioeconomic development, and ecological sustainability (Owusu et al., 2016).

In developing countries like Ghana, manually operated switches controlling water pumping systems lead to wasteful electricity consumption and imbalanced water distribution, causing overflows or inadequate filling of tanks (Mytton, 2021). This results in unnecessary water and energy loss, highlighting the need for intelligent and automated water management systems. This research paper design an automated water tank filling system focusing on developing country (Ghanaian) communities. The paper used technologies like the esp32 microcontroller, ultrasonic sensor, LCD screen, relay module, voltage regulator, solenoid valve, and solar panels with rechargeable batteries the system aims to optimize water usage, reduce wastage, and promote sustainable practices. The methodology section outlines the system design, results analyze findings, and conclusions offer recommendations for integrating intelligent systems into water management. Overall, the paper demonstrates an innovative automated system to address

pressing water challenges, contribute to sustainability, improve efficiency, and empower developing communities through optimized water usage and conservation (Owusu et al., 2016).

## 2. LITRATURE REVIEW

Water is a vital yet limited resource, so developing intelligent systems for optimized management is crucial. Manual water pumping systems used in developing nations like Ghana lead to imbalanced supply and electricity wastage, hence automated systems are needed (Mytton, 2021). This paper explores designing an automated water tank filling system using technologies like microcontrollers, sensors, solar panels, and batteries to enable smart water usage in Ghanaian communities (Owusu et al., 2016).

Prior studies have explored various systems. Barbade et al. (2021) developed a system using level sensors and circuits to automatically activate pumps based on thresholds. However, limitations like sensor inaccuracy, power dependency, and maintenance needs were noted. Patil and Singh (2014) used individual pumps and contact sensors for level-based control, but could not provide precise readings. Baballe et al. (2022) reviewed systems using float switches and controllers for automatic pump control to prevent wastage. But risks like sensor damage from water flow necessitated safety measures. Ahmed et al. (2018) used float switches and a microcontroller, but faced limitations regarding sensor accuracy. Hazbi and Ma (2023) designed a system using NodeMCU and IoT for remote monitoring and automated filling, but noted dependency and maintenance challenges.

Several studies utilized IoT for smart management. Singh et al. (2019) developed a comprehensive urban system using sensors, analytics, and real-time monitoring to optimize supply and reduce losses. But sensor and data issues were noted. Lee et al. (2020) proposed wireless sensor networks for automated tank filling and remote monitoring, though calibration and power challenges existed. Jain et al. (2019) used IoT sensors, data transmission, and apps for monitoring, but highlighted sensor and connectivity limitations. Olatunji et al. (2020) automated agricultural systems using sensors, microcontrollers, and actuators, while recognizing power and robustness needs.

Multiple studies highlighted benefits but also challenges of systems. Gupta et al. (2019) proposed urban IoT systems for monitoring and optimization, but noted sensor and cybersecurity issues. Li et al. (2017) reviewed wireless networks for water quality monitoring, though sensor and power concerns existed. Rahman et al. (2020) found smart metering reduced wastage and improved billing, but privacy and costs were concerns. Al-Nahar et al. (2021) explored IoT benefits like leak detection, but raised sensor and security challenges. Mishra et al. (2020) showed agricultural promise but highlighted awareness and technical barriers. Kumar et al. (2019) provided an IoT overview, acknowledging security and scalability challenges. Alaraje et al. (2020) presented an IoT design for quality monitoring, while noting sensor and calibration issues.

Additional relevant studies include: Kumar et al. (2021) proposing IoT-based systems, but noting communication and security needs; Sharma et al. (2016) exploring wireless networks for quality monitoring, though citing accuracy and efficiency requirements; Kumar and Khare (2020) investigating smart systems but highlighting sensor and data concerns; Sharma and Singh (2019) examining urban IoT benefits but acknowledging infrastructure challenges.

Previous research demonstrates the potential of automated and IoT-based systems for optimized water management through remote monitoring, data analytics, and automatic control (Owusu et al., 2016; Lee et al., 2020). However, ongoing challenges related to aspects like sensor reliability, maintenance, costs, connectivity, and cybersecurity must be addressed, especially in developing world contexts (Baballe et al., 2022; Kumar & Khare, 2020; Owusu et al., 2016). This highlights the need for continued innovation to create robust, efficient, and intelligent water management systems.

### 2.2 THEORETICAL FRAMEWORK

The theoretical framework for this research revolves around control theory, which is a suitable theory for this research as it provides a systematic approach to designing and optimizing intelligent automated water tank filling systems. Control theory focuses on developing algorithms and strategies to control and regulate systems to achieve desired behaviors. In this context, the theory can be used to design algorithms that continuously monitor water levels, water consumption patterns, and environmental factors to optimize water usage. (Zhang & Zhou, 2022) Employing control theory principles, the system can adjust the water flow rates, optimize the filling schedules, and maintain water levels within an optimal range, thereby ensuring efficient water usage and sustainable water management.

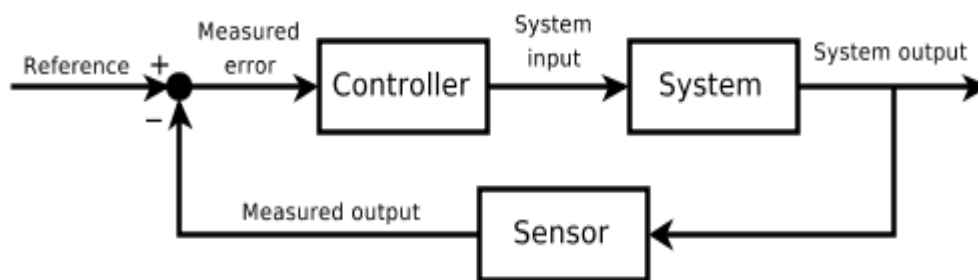


Fig. 1: Control theory  
Source: (Zhang & Zhou, 2022)

### 2.2.1. DEFINITION OF CONSTRUCTS

The study leveraged control theory to guide the system design, incorporating key stages like sensors for data acquisition, a controller for processing inputs, reference algorithms for decision-making, actuators to execute actions, continuous feedback, and optimization. Specifically, the Ultrasonic sensor measures water levels, the ESP32 microcontroller analyzes the data, the control system determines appropriate actions based on water level thresholds, the solenoid valve is triggered to fill the tank accordingly, the LCD displays the status, feedback loops enable adjustments, and algorithms optimize the filling process for efficiency and sustainability. This sensor-controller-actuator feedback control loop with real-time monitoring and optimization enables precise, automated management of water tank filling aligned with the project's sustainable water usage goals.

## 3 RESEARCH METHODOLOGY

The study used qualitative methods along with the RAD approach. RAD is a structured and iterative software development process that emphasizes user involvement, prototyping, and rapid feedback. (Daraghmi & Daraghmi, 2022). In the context of this study, RAD was applied to efficiently design, develop, and optimize the intelligent automated water tank filling system. The methodology involves the following stages: Requirements Gathering, User Design, Construction and Cutover. At the User Requirements Gathering stage of this study, the researchers purposely selected 20 participants to include in the study. Interviews were conducted with the 20 participants using an interview guide to collect data for the study, observed the existing water management systems, and a comprehensive review of relevant documents. This was to identify specific requirements of the users and desired system functionality for the study.

## 4. RESULTS

### 4.1 RAPID APPLICATION DEVELOPMENT MODEL

This project adopted the Rapid Application Development (RAD) methodology, software development approach that emphasizes rapid prototyping and minimal pre-planning. This methodology allows for quicker development and facilitates easier adaptation to changing requirements. The RAD model comprises four key stages: Requirements Planning, User Design, Construction, and Cutover. These stages are essential for effectively designing and optimizing the intelligent water tank filling system to meet the objectives of sustainable water management.

Figure 1: Rapid Application Development Model  
 Source: (Hamzah et al., 2019)

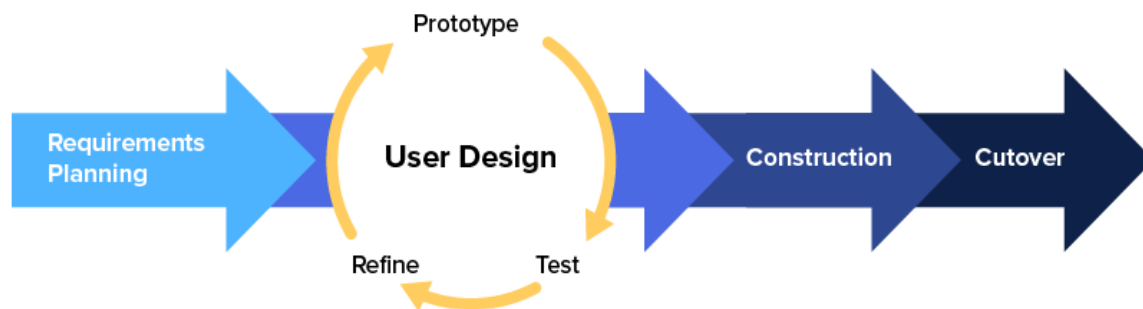


Figure 2. Phases in the Rapid Application Development (RAD) Model

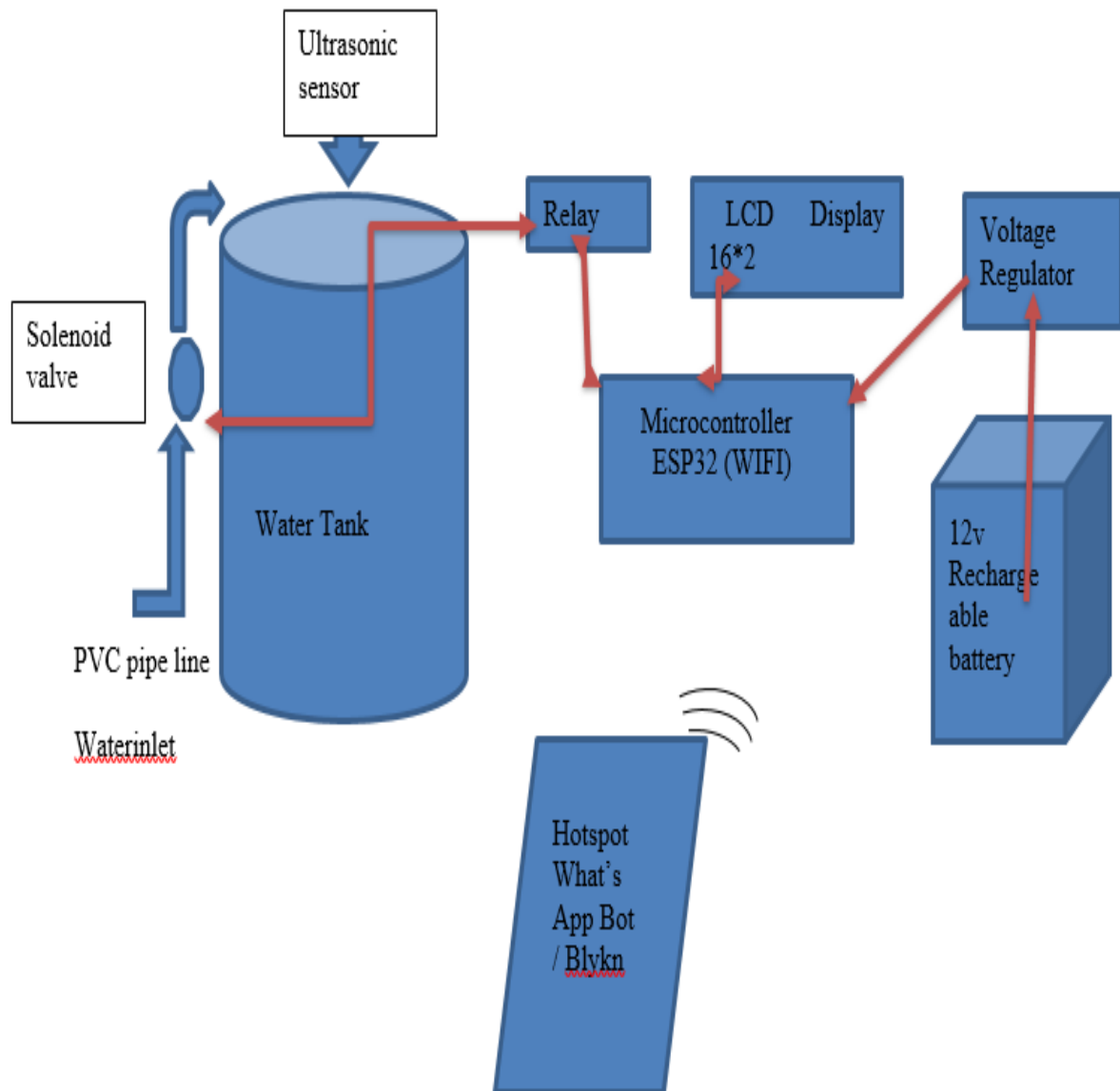
## 4.2 REQUIREMENTS PLANNING

The study gathered essential requirements for developing an intelligent automated water tank filling system by interviewing diverse participants, including university students, households, landlords, tenants, engineers and plumbers. Interviews focused on experiences with water tanks, management practices, and desired features for optimization. The majority (90%) of participants used water tanks, with 80% having dealt with overflows and 60% facing high electricity consumption. Most (90%) had experience with automated tanks. Additionally, over a year of observations by researchers revealed challenges with manual filling including imbalanced demand and supply, causing overflows or inadequate filling. Key benefits of the proposed system highlighted were optimized usage, reduced wastage, enhanced sustainability, and improved management through preventing overflows and regulating levels. Concerns were raised about initial costs, technology dependency, and user-friendly designs. Current manual methods of gauging water levels were deemed unreliable, often leading to shortages. Larger tanks enabled longer supply, while smaller ones required more frequent refills. Accurate, real-time data was considered essential for planning and conservation. Recommendations included regular maintenance, durable sensors, and mobile app integration for remote monitoring and notifications. Generally, participants welcomed an intelligent system but stressed the importance of affordability, reliability, and intuitive design.

## 4.3 USER DESIGN

At the user design stage, developers created sketches and visual representations by using Unified Modeling Languages (UMLs) like Block Diagram (BD), and Data Flow Diagrams (DFD). An again moved on to develop a quick prototype of the system, for respondents from the study to engaged, test the and provide invaluable feedback. This iterative process facilitated the refinement of the design, ensuring that the system is intuitive, user-friendly, and well-suited to enhance sustainable water management. The focus extended to creating an interface and

interactions that prioritize safety and efficiency in water resource utilization.



**Figure 2: Block Diagram of the System**



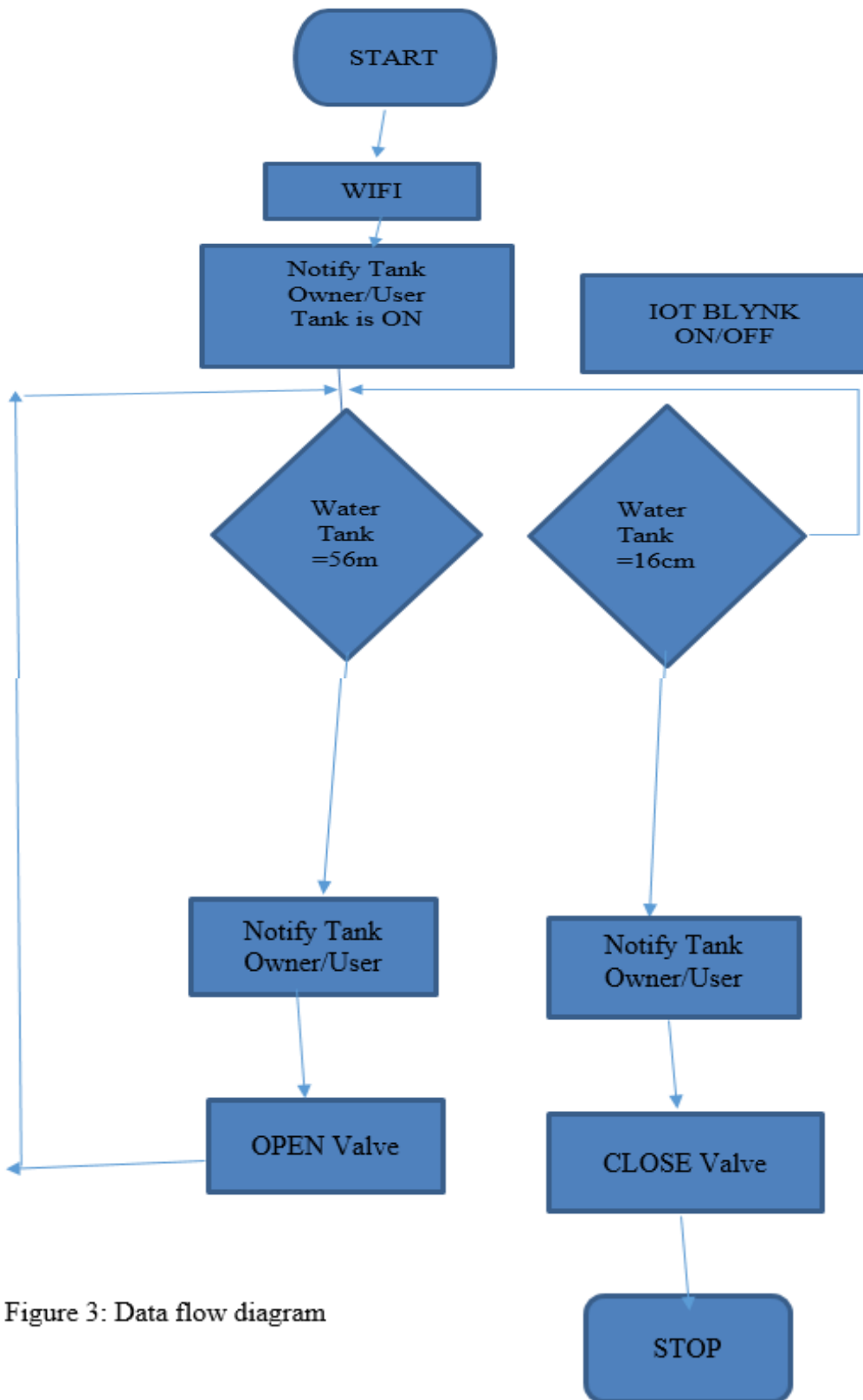


Figure 3: Data flow diagram

## **4.4 CONSTRUCTION**

The construction phase involved collaborative planning, component selection, prototyping, iterative testing, and user-centric validation to build the system (Hehn & Mendez 2022, Avital et al. 2023). A parallel implementation approach allowed the manual and automated systems to co-exist during deployment, enabling a smooth transition (Human, 2023). The harmonization of hardware and software aimed to achieve sustainable water management through cutting-edge integration.

## **4.5 CUTOVER**

The Cutover phase involved thorough pre-deployment testing and optimization of the system's hardware and software. Selected real-world locations like households and universities were identified for installation by technicians, along with user training for operation and troubleshooting. Continuous monitoring enabled data gathering on performance and usage patterns for issue identification and resolution. User feedback throughout this transition from development to full implementation allowed fine-tuning of parameters and interfaces for optimal functionality and user satisfaction (Human, 2023). Successful system deployment and integration contributed to sustainable water management goals.

## **5 CONCLUSION**

In conclusion, this paper presents the design of an automated water tank filling system using advanced technologies to promote optimized and sustainable water management. The system efficiently monitors levels and controls pumping via a microcontroller and valve to prevent wasteful overflows. Components like sensors, solar panels, batteries, and displays enable intelligent automation for precision filling. The methodology incorporated user-centric design and real-world testing to maximize practicality. Overall, the innovative system provides a reliable, energy-efficient solution to improve water conservation, reduce losses, and empower communities through technology integration. The research contributes a valuable framework for leveraging automation and the Internet of Things to tackle pressing water resource challenges.

### **5.1 RECOMMENDATIONS**

This paper exemplifies a meticulous, user-centered approach to developing an intelligent automated water tank filling system with immense potential for sustainable impact. The thoughtful integration of advanced technologies like microcontrollers, sensors, and solar power demonstrates an innovative solution to pressing water management challenges. The real-world simulations and continuous optimization based on end-user feedback showcase the system's adaptability and practicality for widespread adoption. Given the tangible innovation, solid methodology, and revolutionary capacity to optimize water usage through precision automation, this work represents a profoundly valuable contribution worthy of strong recommendation for implementation and future research

### **5.2 SUGGESTIONS FOR FUTURE STUDIES**

While this intelligent system presents an innovative solution for optimizing water tank filling, additional enhancements could further improve efficiency and sustainability. Future studies can explore integrating smart water quality monitoring using sensors to detect contaminants. Incorporating AI and machine learning algorithms may enable automatic anomaly and leak detection for preventative maintenance. Expanding the system to manage multiple tanks simultaneously could aid larger scale implementations. Assessing environmental and economic

impacts would also quantify sustainability benefits. Overall, augmenting the system's capabilities through new technologies, expanded scope, and impact evaluations represents promising directions for advancing intelligent water management.

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