

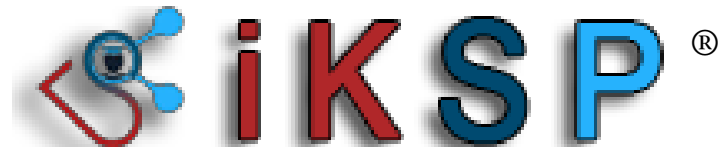
iKSP JOURNAL OF COMPUTER SCIENCE AND ENGINEERING (iJCSE)

Vol-II Issue-I

ISSN-Online: 2701-7095

ISSN-Print: 2701-7176

<https://iksp.org/journals/>



iKSP Journal of Computer Science and Engineering (iJCSE)

Volume-II

Issue-I

January– 2022

Published by

iKSP Publisher

ISSN-Online: 2701-7095

ISSN-Print: 2701-7176

Innovative Knowledge Sharing Platform®

<https://iksp.org/>

iKSP Journal of Computer Science and Engineering (iJCSE) is an Open Access, Blind Peer Reviewed research journal published biannually. ***iJCSE*** provides readers with a compilation of stimulating and up-to-date articles within the field of computer science and Engineering. The focus of the journal is on high-quality research that addresses paradigms, development, applications, and implications in the field of computer science.

Aim and Scope of *iJCSE*

iKSP Journal of Computer Science and Engineering (iJCSE) aims to publish cutting-edge original research in the fields of computer science and Engineering. The topics related to this journal include but are not limited to:

• Image processing	• Transmission and conversion
• Information theory	• Acoustics, speech & signal processing
• Software engineering	• Robotics and automation
• Remote sensing	• Wireless and mobile communication
• Neural networks	• Antennas and propagation
• Complex Networks	• Control theory & industrial controls
• Secure coding and algorithms	• Automation, control and IS
• Big Data	• Software reliability and security
• Access control	• Security for wireless networks and Sys.
• Control systems	• Information security for business
• Circuits and systems	• Encryption and authentication
• Data and network recovery	• Privacy protection technology
• Attack and defense	• Cryptographic and security protocols
• Image processing	• Transmission and conversion

Disclaimer: The opinions expressed in *iKSP Journal of Computer Science and Engineering (iJCSE)* are those of the authors and contributors, and do not necessarily reflect those of the journal management, advisory board, the editorial board, **iKSP Publisher** or the organization to which the authors are affiliated. Papers published in *iJCSE* are processed through blind peer-review by subject specialists and language experts. Neither the *iKSP* nor the editors of *iJCSE* can be held responsible for errors or any consequences arising from the use of information contained in this journal, instead errors should be reported directly to corresponding authors of articles.

Editorial Team

Editor in Chief:

Dr. Hafiz Abid Mahmood Malik
Arab Open University Bahrain

Editor:

Dr. Ahmad Waqas
Florida International University, USA

Managing Editor:

Dr. Hafiz Muhammad Asif
Sultan Qaboos University, Oman

Advisory Board Members:

Dr. Yonis Gulzar
King Faisal University, Saudi Arabia

Dr. Abdul Rehman Gilal
Universiti Teknologi Petronas, Malaysia

Dr. Nadeem Mahmood
University of Karachi, Pakistan

Dr. Habib Shah
King Khalid University, Saudi Arabia

Dr. AbdulHafeez Muhammad
Department of Computer Science, Bahria University, Pakistan

Dr. Imran Anwar Ujan
Faculty of Engineering & Technology, University of Sindh

Dr. Rawad Abdulghafor
International Islamic University Malaysia

Dr. Shahmurad Chandio
Institute of Mathematics and Computer Science, University of Sindh Jamshoro

Dr. Joy Witson
University of Technology Bahrain

Publication Cycle

The Journal is published biannually in July and January.

Open Access Policy and License

iKSP Journal of Computer Science and Engineering (iJCSE) provides immediate open access to its freely available contents to the public and supports a greater global exchange of knowledge. Researchers can copy and redistribute the material in any medium or format following the CC-BY license. Authors can self-archive the publisher's version of the accepted article in digital repositories and archives. Following acceptance, paper(s) will be immediately available online after the necessary format. *iJCSE* allows the author(s) to retain publishing rights without restrictions.

License



Attribution 4.0 International (CC BY 4.0)

All articles in iJCSE are published under the terms of the Creative Commons (<https://creativecommons.org/licenses/by/4.0/>) Attribution 4.0 International License, which permits copying and redistributing the material in any medium or format.

Copyright

iKSP Journal of Computer Science and Engineering (iJCSE) is an open-access journal which means that all contents are freely available without charge to the user or institution. Users can read, download, copy, distribute, print, search, or link to the full texts of the articles in this journal without asking prior permission from the publisher or the author.

Open-access authors retain the copyrights of their papers. All open access articles are distributed under the terms of the (<https://creativecommons.org/licenses/by/4.0/w>) which permits unrestricted use, distribution, and reproduction in any medium the original work is properly cited. Even if not specifically identified, the use of general descriptive names, trade names, trademarks, and so forth in this publication does not imply that the relevant laws and regulations do not protect these names. While the advice and information in this journal are believed to be true and accurate on the date of its going to press, neither the authors, the editors, nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, concerning the material contained herein.

Contact Information

Principal Contact:

Editor in Chief

editor.ijcse@iksp.org

Support Contact:

iKSP Support Team

iksp.journals@gmail.com

iKSP Publisher ®

<https://iksp.org/>

Table of Contents

Sr. No	Paper Title Author(s) Name	Page No.
1.	An Empirical analysis on the factors influences the wastage of Banana and Cherries Cross sectional study of supply chain in UAE Sameera Iqbal, Ahmed Abdulsalam Alzarooni, Rashid Saif Alkaabi, Abdulaziz	01 – 13
2.	Impact of Digital Technology and the Need for Periodical Review of Educational Curriculum in Nigeria Tertiary Institutions Najeem Olawale Adelakun	14 – 19
3.	Opportunistic Cooperative Relaying Protocol for UAV-assisted Flying Adhoc Network Muhammad Nauman Bashir, Kamaludin Mohamad Yusof	20 – 26
4.	Heat Stroke Prevention Wearable Based in Internet of Things (IOT) FARIZA ZAHARI, Sangheeta Maniran, Kumudhini Devi Arul Selvam, Indumathi Ganason	27– 33
5.	ALICE Pattern Matching Based Chatbot for Natural Language Communication: System Development and Testing Munaveer Karimeni Peedikayil Tharammal, Muhammad Nauman Bashir, Kamaludin	34 – 42

An Empirical analysis on the factors influences the wastage of Banana and Cherries: Cross sectional study of supply chain in UAE

Dr. Sameera Iqbal*, Ahmed Abdulsalam Alzarooni, Rashid Saif Alkaabi, Abdulaziz Ahmed Aljefri, Mohamed Saleh Aljabri, Abdullah Sultan Alrumaithi, Yousef Ahmed Alshamsi

Department of Engineering Technology & Science, Logistics Engineering, Higher Colleges of Technology, UAE

Abstract - The research highlights main critical points related to controlling wastage of banana and cherries. Above all there are: the limited shelf-life, packaging, delivery time sensor and costs that can influence the wastage. However, methodological framework suggests that Packaging under the influence of efficient sensors and cost, forces the supply chain to be shaped as both responsive to the market (by reducing the wastage) as well as efficient. The study uses a theory building approach which adopted a qualitative research method. The research strategy includes a preliminary desk research followed by a qualitative research composed by interviews with experts in the field. All interviews were constructed using open-ended questions either executed face to face or through phone calls. The questionnaire was also distributed among different retailer, wholesalers and manufactures.

Keywords: Banana and Cherries, Wastage, Packaging, Delivery time, Shelf Life, Cost, Sensors, Supply chain

INTRODUCTION

Food security throughout the world is a major concern for every living being (Verghese, Lewis, Lockrey & Williams, 2015). More of losses causes a nightmare to dealers who run their businesses with small profit margins (de Gorter, Drabik, Just, Reynolds & Sethi, 2021). Food loss can range from 25 to 50 percent due to improper processing and packaging (or a lack thereof), particularly in impoverished nations. Much of the losses is incurred during transportation and storage of especially perishable goods. The shipment of rotten perishable items to the European Union are abandoned owing to poor quality or rotting (AVETISYAN, 2021). Non-optimized handling throughout supply chain procedures is responsible for a large portion of such losses (Jedermann, Nicometo, Uysal & Lang, 2014). Consumer expectations for year-round availability of fresh fruit and vegetables have been driven by the expansion of infrastructure, facilities, and technology across the supply chain, as well as the deregulation of the global economy (Falagán & Terry, 2018). Customers expect fresh fruits to reach to the destination. In UAE, along with other fruits Bananas remained the most popular fruit and popular among consumers all around the world (Siddique, Shoaib & Jan, 2020). Fruit classified as superfoods, on the other hand, had the fastest growth rates. Especially cherries, which have all seen an increase in demand (Siddique, Shoaib & Jan, 2020; Abro et al., 2020). The major threats to the good state of these fruits are found to be ripening and delicate skin for bananas and cherries respectively due to packaging. Fruits, as we all know, are living organisms that continue to breathe even after harvesting and can only stay fresh for as long as normal metabolites are present (Malik 2017; Mukama, Ambaw & Opara, 2020). Bananas upon ripening produce their own threat i.e. ethylene which is responsible for their uncontrolled ripening. An injury/shock to any of the bananas makes the ripening more

*Corresponding author:

Email: sameeraiqbal786@hotmail.com (S.Iqbal)

[iKSP Journal of Computer Science and Engineering \(2021\) 2\(1\): 1-13](#)



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

severe. Cherries on the other hand can only last for only a week especially if they are well handle and preserved. As per consumer purchasing behavior, they would not like to buy bitter and astringent taste of banana and cherries for the value of their money. In this article the study focuses on the most important aspects of the factors that influence the wastage of banana and cherries as well as how we can improve them based on the findings collected from the different businesses related to food industry across UAE.

Research Orientation

The goal of this study is to come up with a possible supply chain arrangement for the banana and cherries in UAE. The research is design-oriented since it attempts to systematically evaluate perishable fruits by putting the literature on supply chains to investigate the existing banana and cherries supply chain in UAE empirically.

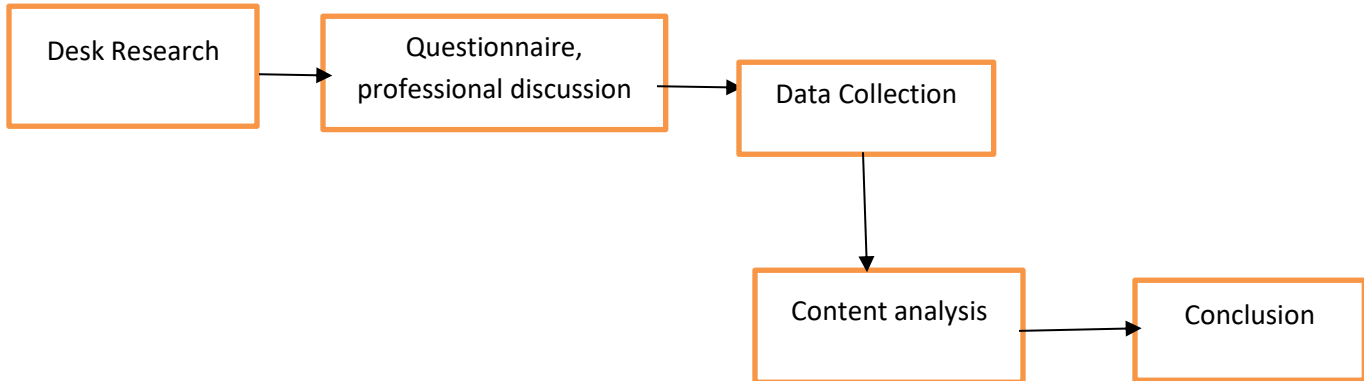


Figure 1: Research Orientation

Research objective

Following objective can be formulated after having analyzed the background and orientation of the research: “To provide recommendations on logistics and Packaging options for the Bananas and cherries supply chain by analyzing existing literature on fresh fruit supply chain behavior, by assessing the current practices on supply chain of banana and cherries and by investigating supply chains in the fresh fruit business”

Research framework

The research framework in Figure 2 shows a schematic overview of the research procedures. It is divided into four phases, each of which will be discussed.

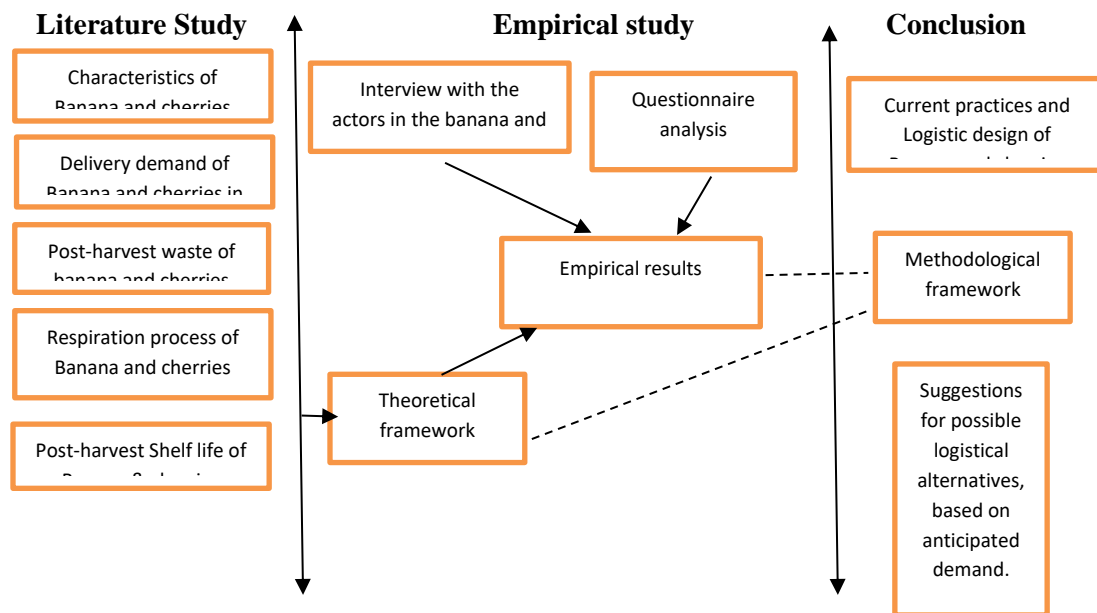


Figure 2: Schematic overview of the research procedures

LITERATURE REVIEW

Characteristics of banana and cherries

Bananas are a climactic fruit, ripening of bananas is caused by enzymatic reaction which when triggered tends to be very fast (Maduwanthi & Marapana, 2019). Ethylene and high concentrations of carbon dioxide cause bananas to ripen very fast. These compounds catalyze the enzymatic reaction. The green life of the bananas is thus reduced causing them to spoil before they can reach the market or any other processing facility. Damaged bananas are more lethal because they produce high amounts ethylene and this causes the ripening of other bananas in the same container to increase exponentially (Maduwanthi & Marapana, 2019; Khattak et al., 2020, October). Cherries on the other hand are non-climactic fruit and has more disadvantaged due to thin skin which tend to be very delicate (Abell, 2021). Poor handling is likely to cause injury to the fruit which leads to rapid spoilage. It is also important to understand the respiration of bananas and cherries to get better knowledge of packaging and handling.

Delivery Demand of banana and cherries in UAE

While the UAE is one of the world's wealthiest and most dynamic countries, with a GDP per capita rating of 13th in 2017 (Abdulaziz Alshareef, 2012). UAE is home to one of the world's most multicultural societies. In 2018, the UAE's overall population was 9.3 million, with yearly growth rates of roughly 1.5 percent predicted to reach 9.9 million by 2022 (Abdulaziz Alshareef, 2012). Overall, apparent consumption of imported frozen fruit and vegetables has slowed in recent years as customers have moved away from frozen goods in favor of fresh produce. Growing health consciousness has resulted in a desire to eat more natural foods, reducing demand for processed fruits and vegetables. The total proportion of consumer spending allocated to food and beverages (14 percent) and its share of the country's GDP (5 percent). Although it remained below the global averages (16 percent and 9 percent), respectively, in 2017. However, it is witnessed that purchases of fresh fruits including banana and cherries have increased especially after pandemic (Pandemic purchasing, 2021).

Post-harvest waste of banana and cherries

Studies revealed that 1.4 million bananas thrown away each year (1.4 million bananas thrown away each day reports Snact). One study reveal that \$65 billion a year in food waste happens which includes cherries and other fresh fruits (Kate Prengaman, 2019). Fruit quality is defined as the extent to which a set of natural traits meets the expectations of customers (2021). Damage to fruits can occur anywhere in the post-harvest supply chain (SC). Such as damage refer to vegetation from using equipment and from weather related events, damage during handling and packaging compression (2021). It was also discovered that damage could be caused due to vibration in transit and stack height of the package and stack position of the pallet (2021).

Respiration Process of bananas and cherries

Respiration of bananas and cherries increases when the ethylene production increases. Ethylene production increase when there is hot temperature (Gane, 1936). Studies revealed that if theses fruits are kept in a controlled environment where there is an increase of carbon dioxide and decrease of oxygen, then we can delay the process of respiration which in result will reduce the ethylene production (Gane, 1936). Intermediaries and production companies suffer a big loss if bananas overripe before they could reach the desired destination (market, wholesale or processing sites/companies). This is because once bananas start ripening the process cannot be stopped and current techniques of slowing it down are very expensive and less effective. Similarly, cherries have a very high spoilage rate and require care when handling. For Both fruits, spoilage cannot be delayed once it starts.

Post-harvest shelf life of banana and cherries

For direct consumption of cherries and bananas there is an extended post-harvest shelf life to facilitate long-distance transportation and ensure that the fruit arrives at markets in good condition (Habib, Bhat, Dar & Wani, 2015). Researchers have estimated the shelf life of cherries 7 – 14 days on cold atmosphere (Habib, Bhat, Dar & Wani, 2015; (Haq, Nawaz, Akram, & Natarajan, 2020). Whereas shelf life of bananas estimated to be 2-7 days at counter and 2-9 days in refrigerator ("How Long Do Bananas Last? Shelf Life, Storage, Expiration", 2021). The shelf life of cherries and bananas are highly influenced by a variety of factors such as harvest timing, correct handling and cooling techniques, and, above all, packaging (Habib, Bhat, Dar & Wani, 2015).

Logistics design of banana and cherries

The proposed solution to this problem would be more applicable to logistic companies who directly transport these produces for the intermediaries to the production, then to wholesalers. It will also be used by wholesalers, marketer, caterers and retailers for storing and ease movements within the store and transport over short distances.

Current practices

The currently available products which can perform similar functions involves the regulation of ethylene production, control of ethylene perception, suppression of polygalacturonate activity. This is done using Delayed Ripening

Technology (Maduwanthi & Marapana, 2019; Ul Haq, Malik, Akram, & Al Mutawa, 2020, December). Fridges are also being used to reduce ripening of bananas and for keeping cherries fresh. Cherries are currently being packaged in transparent plastic containers or small-sized cartons. This type of package does not guarantee safety of the cherries' delicate skin since they are kept under pressure from each other. Since the approach of reefer holders during the 1960s, they have reformed the manner by which transitory products are shipped and have supplanted conventional reefer ships as the dominating method of moving produce in controlled conditions. Reefer holders have just improved from that point forward as, after some time, enhancements in innovation have made reefers more proficient. This is particularly significant considering the way that the seaborne short-lived exchange is relied upon to develop by 5% every year among now and 2020. For organizations that manage short-lived merchandise, reefer holders will probably be a vital part in inventory network (Akram et al., 2020; Rana, Kumar and Prasad, 2021).

THEORETICAL FRAMEWORK

Three primary themes were studied through the literature review: Packaging, delivery time and storage. The researchers hypothesized that there is a link packaging, delivery time and storage on banana and cherries wastage.

The connection between those three ideas allows for the creation of some distribution scenarios that are based on time, cost, and sensor quality.

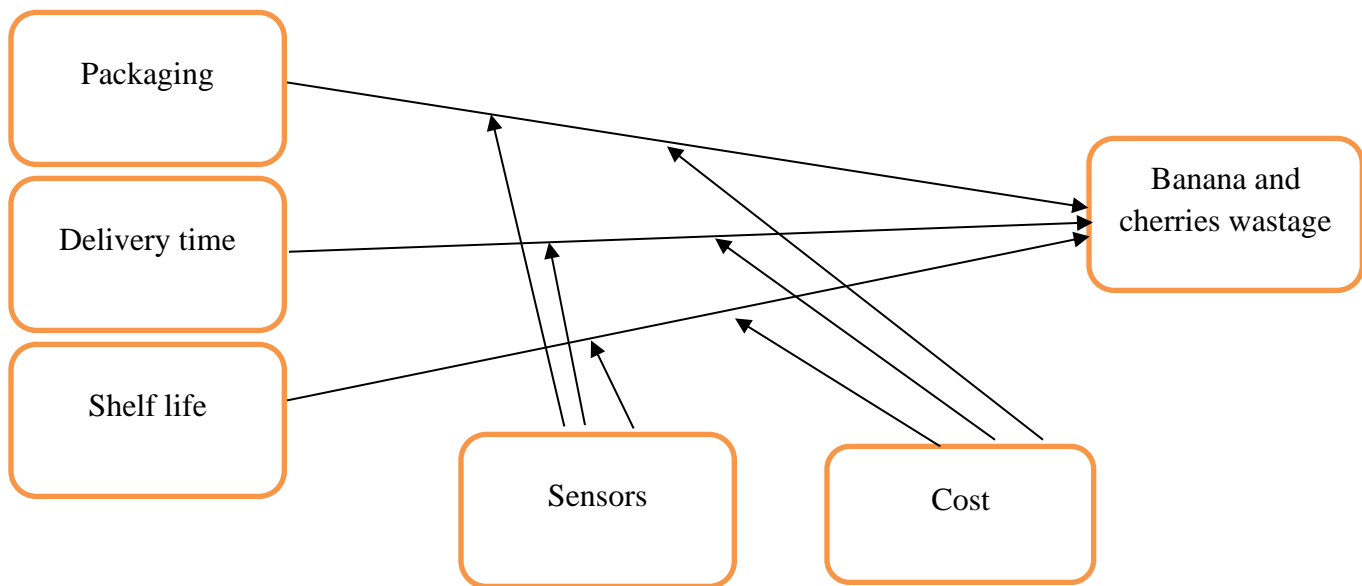


Figure 3: Theoretical Framework

Research Questions

First, the main research question was given. The main research question is then divided into 5 research framework phase. At last, the research questions per phase are divided into sub-questions. Those 5 research areas were banana and cherries wastage, time, storage, sensors and packaging. Likert scale, open ended and closed ended type of questions were designed to have interview and questionnaire from the retailers and wholesalers. The same set of question were asked in the interview as well. There were some categorical questions, also asked to get to know the information about demographic and types of businesses and activities.

PART A

Demographics

The survey study we report on took place in UAE and involved face-to-face, telephonic and online survey encounters with respondents in seven Emirates of UAE. These companies belong to either retail/grocery stores, warehouses or transporting perishable fruits. Because our findings apply equally across all states and companies, we do not make comparisons within the sample considerable amount of input from Dubai that is 57.1 %, followed by Abu Dhabi with 28.6% respondent's data.

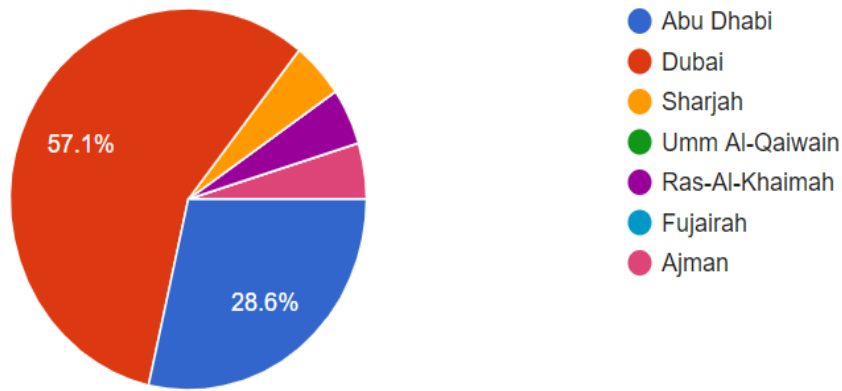


Figure 4: Demographics

Gender

Female contribution is observant in supply chain industry. Female contribution in supply chain is very minor and contains 14.3 percent of the proportion. Whereas, supply chain industry show more male contribution.

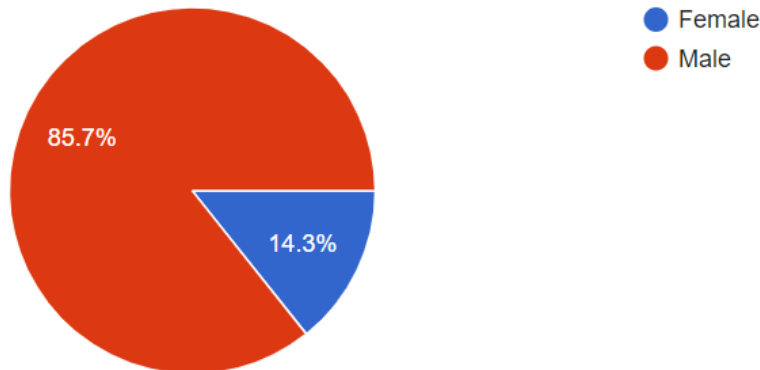


Figure 5: Gender

Time spent working in food industry

The Pie chart represents that 47.6% of respondents are in food industry more than 5 years and 52.4 % are in food industry less than 5 years. That shows that data collected is from experienced people which means data equals knowledge, hence it helps in validating the information and leads to make informed decisions because Knowledge is equal to data. While anecdotal evidence, assumptions, or abstract observation may provide incontrovertible evidence, taking action based on an inaccurate conclusion may result in a waste of resources.

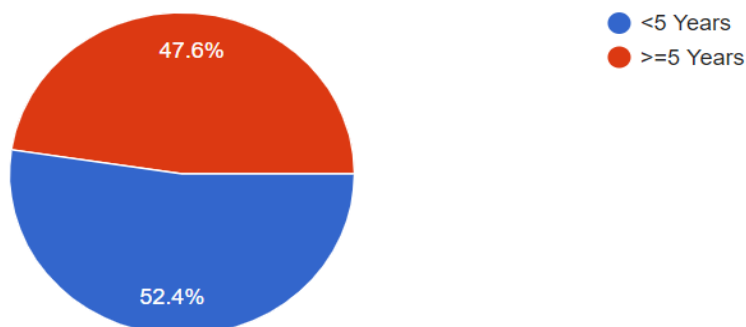


Figure 6: Time spent working in food industry

Type of Food industry that you are associated with:

It is evident from the surveys and face to face data collection that 47.6% were associated with grocery stores/retailers. 28.6% belongs to transporting perishable food and remaining 23.8% are connected to warehouses. This will give us prudent analysis about shelf life, because shelf life will vary for each type of food industry.

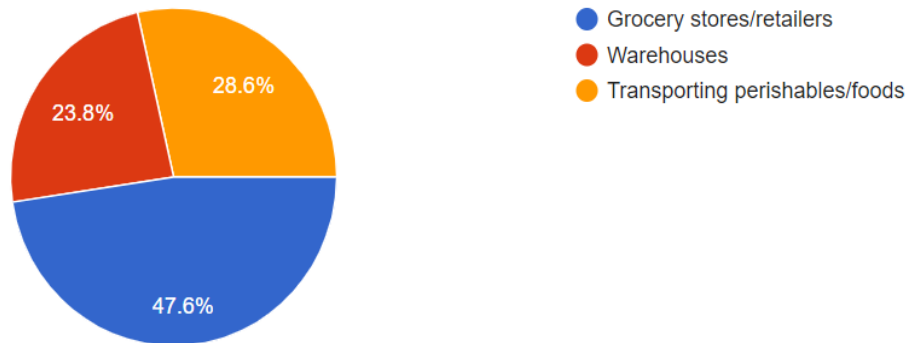


Figure 7: Type of Food industry that you are associated with

Do you know what post-harvest bananas are?

The below pie chart shows the huge proportions businesses aware of post-harvest knowledge of bananas. Whereas only 9.5% shows no understanding of post-harvest bananas.

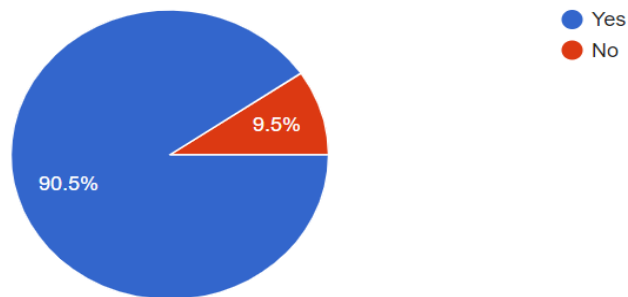


Figure 8: Business awareness of post-harvest bananas

Do you have experience in handling post-harvest bananas?

Majority if the businesses confirm their experience in handling post-harvest bananas whereby 23.8% shows no relevance towards the experience of handling post-harvest bananas but as per the statistics of previous question, some of them do have knowledge of post-harvest bananas.

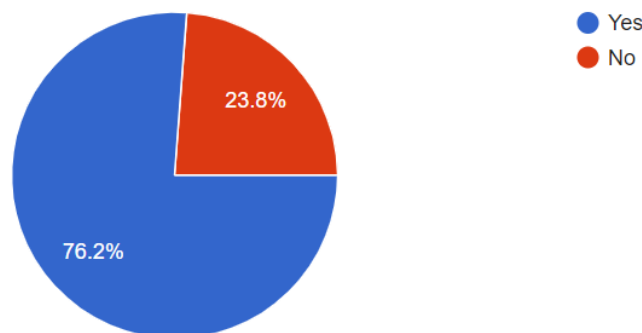


Figure 9: Experience in handling post-harvest bananas

Do you know the maturity stages for post-harvest cherries?

Huge amount of proportion indicates that the 71.4% businesses are aware of the knowledge of post-harvest cherries and 28.6% does not deal with post-harvest cherries.

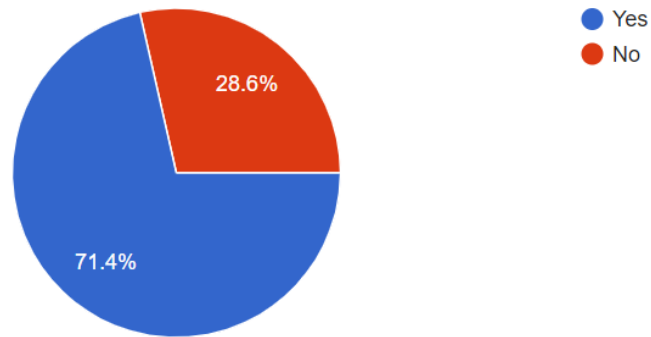


Figure 10: maturity stages for post-harvest cherries

Which maturity stages of cherries do you deal with?

There are total five maturity stages of cherries and bar graph shows that majority of the participants deal with cherries when they are at second maturity stage. After that, third and first maturity stages are common and dealt by the businesses.

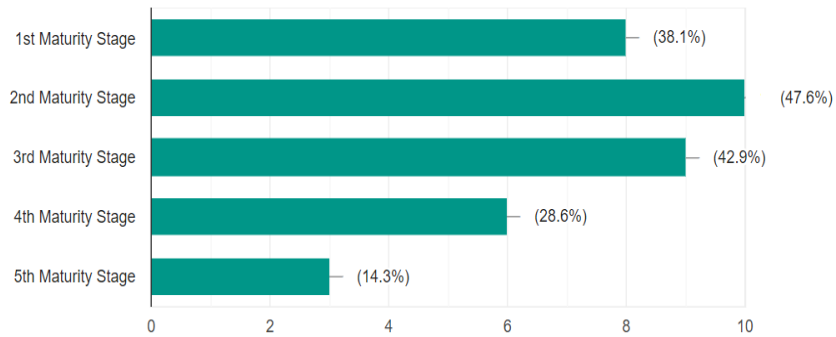


Figure 11: Dealing with maturity stages of cherries

INTERVIEW QUESTIONS

Why you think food waste occurs in your company due to manufacturing sector?

There is minor difference in the proportion of three categories. Over production scores higher followed by packaging and then wrong size.

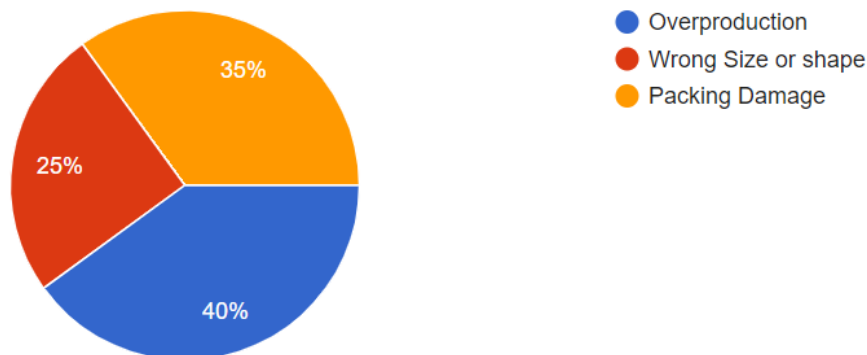


Figure 12 (a): Food waste in manufacturing sector

3.2 Why you think food waste occurs in your company due to retail sector?

Stock mismanagement indicates the biggest indicator of food loss which is related to packaging and handling. Marketing standards contributed 30% towards the wastage and marketing strategies have very low share.



Figure 12 (b): Food waste in Retail sector

What makes you buy a sensor?

It is evident from the results that companies and businesses are concerned with effectiveness and efficacy of sensors and considered it as a priority when they have to purchase it.

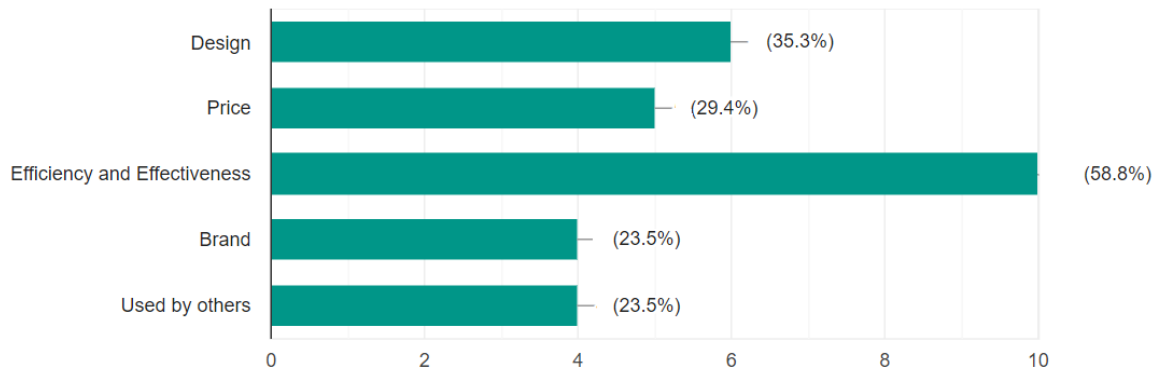


Figure 12(c): Purchase of sensors

CORRELATION RESULTS

We are using Correlation Coefficient indicator to check the strength of our variables. The table below shows the scale of correlation coefficient and its value. Correlation coefficient used to measure the relationship between two variables (Steven, 2021).

Table 1: Scale of Correlation

Scale of correlation coefficient	Value
$0 < r \leq 0.19$	Very Low Correlation
$0.2 \leq r \leq 0.39$	Low Correlation
$0.4 \leq r \leq 0.59$	Moderate Correlation
$0.6 \leq r \leq 0.79$	High Correlation
$0.8 \leq r \leq 1.0$	Very High Correlation

Correlation between dependent and independent variables

Based on the data collected we will check the strength of relationships of dependent and independent variables. Moreover, strength of relationship is also measured among independent variables and mediators. Correlation of independent variables with dependent variables:

Table 2: Correlation between dependent and independent variables

	Packaging	Delivery Time			Shelf life
		Within city	Within country	Out of country	
Banana and cherries wastage	0.636480633	0.004037	0.02354	0.36098	0.1157

Banana and cherries wastage shows high correlation with packaging because the value lies between $0.6 \leq r \leq 0.79$. These results indicate not a very strong relationship between the wastage of banana and cherries and delivery time within the city and delivery time within the country, however, low correlation identified between wastage and delivery time out of country. The coefficient correlation values are 0.004037, 0.02354 and 0.36098 respectively.

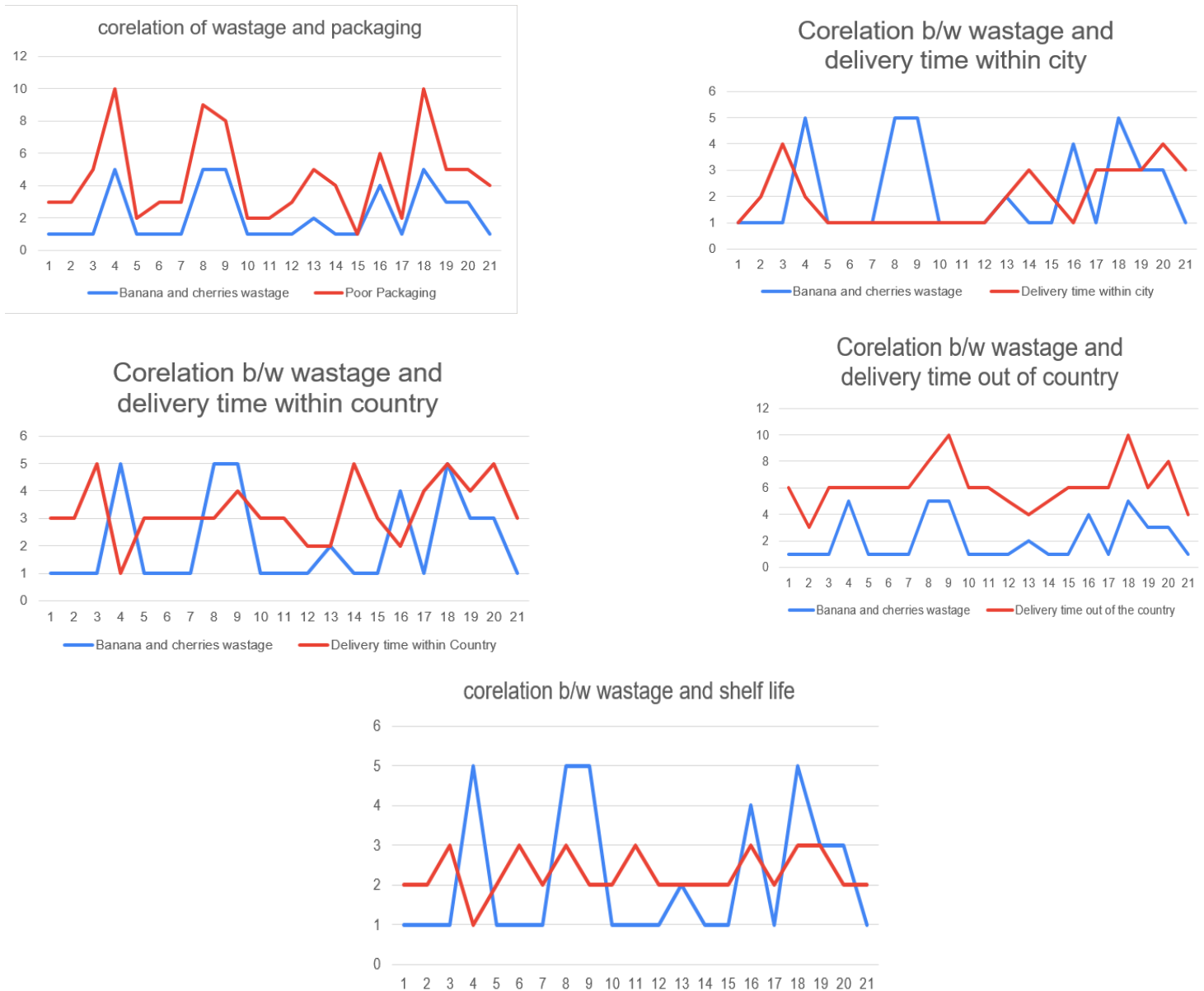


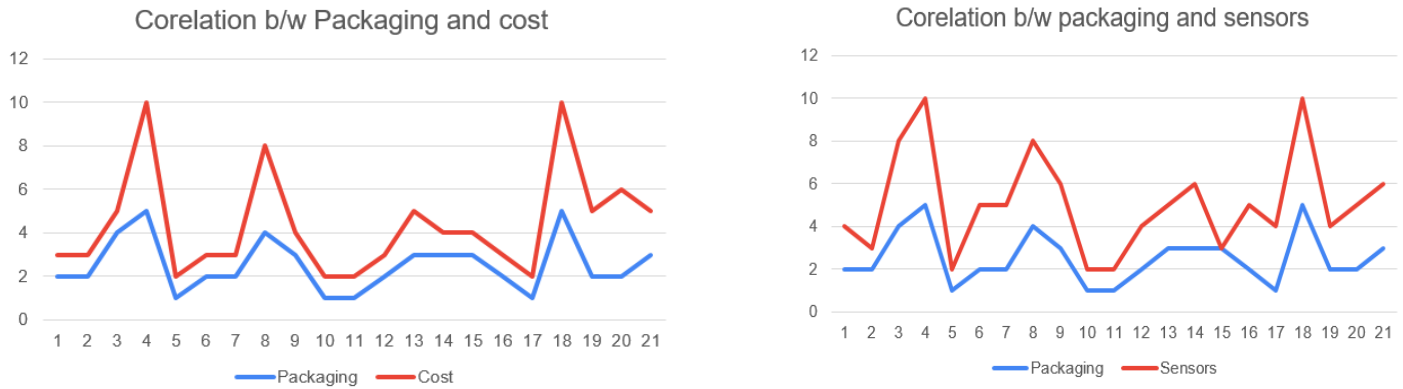
Figure 13: Correlation between dependent and independent variables

The results visible in figure 13 shows that wastage of banana and cherries is also in very low correlation with the shelf life.

Correlation between independent (packaging) variable with mediators**Table 3:** Correlation between independent (packaging) variable with mediators

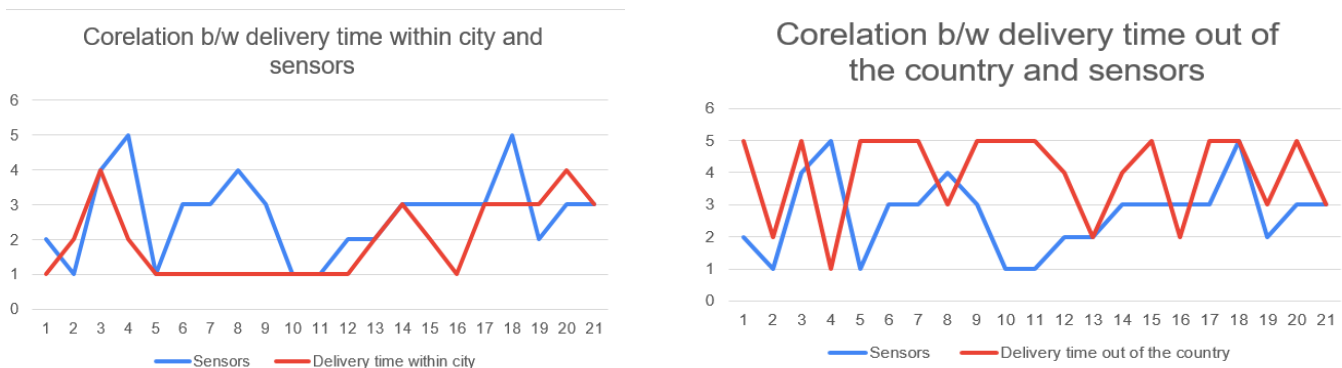
	Sensors	Cost
Packaging	0.839243	0.676997868

Packaging shows very high correlation with sensors and high correlation with cost which reflects that the quality of packaging increases with the durability and reliability of sensor increases. Similarly, investing more on packaging will increase the quality of packaging.

**Figure 14:** Correlation between independent (packaging) variable with mediators**Correlation between independent (delivery time) variable with mediators****Table 4:** Correlation between independent (delivery time) variable with mediators

	Sensors	Cost
Delivery Time within city	0.23918	0.355788192
Delivery Time within country	0.204459	0.059164299
Delivery Time out of country	0.345739	-0.340158989

Given data indicated very low correlation between delivery time within the city as well as within the country with quality of sensors throughout the distribution and storage process. However it does have low correlation with delivery time out of country and having good quality of sensors throughout the supply chain. Similarly, cost has low correlation with delivery time within the city. Cost has almost no relation with delivery time within the country and cost has negative low relationship with the delivery time out of the country. That means delivery time out of the country will increase if we decrease the cost in the supply chain process.



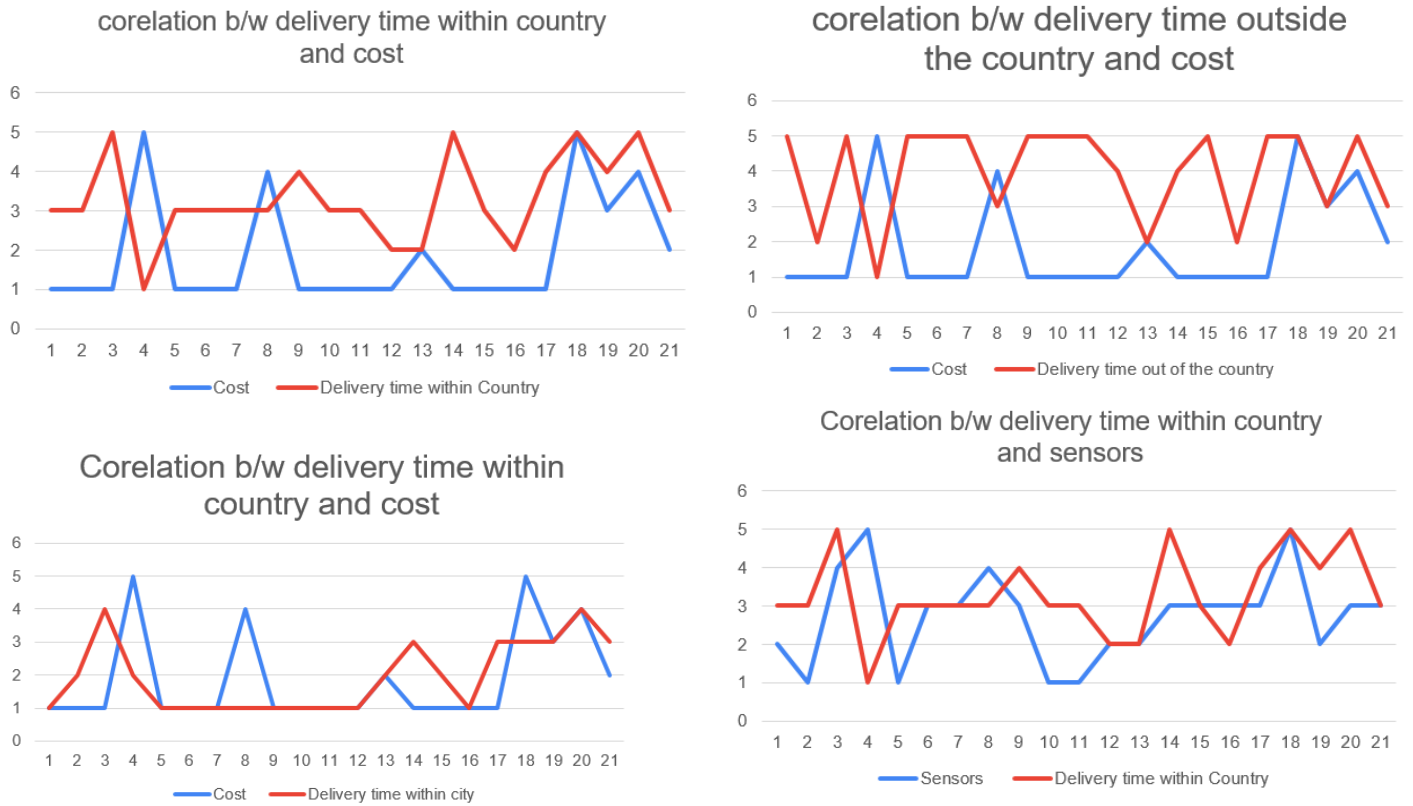


Figure 15: Correlation between independent (delivery time) variable with mediators

Correlation between independent (delivery time) variable with mediators

Table 5: Correlation between independent (delivery time) variable with mediators

	Sensors	Cost
Shelf Life	0.060502	-0.00895

As per given numbers shelf life has almost no correlation with sensors, however, cost has very low negative relation with shelf life. Negative relationship reflects that shelf life increases if cost in the supply chain process decreases.

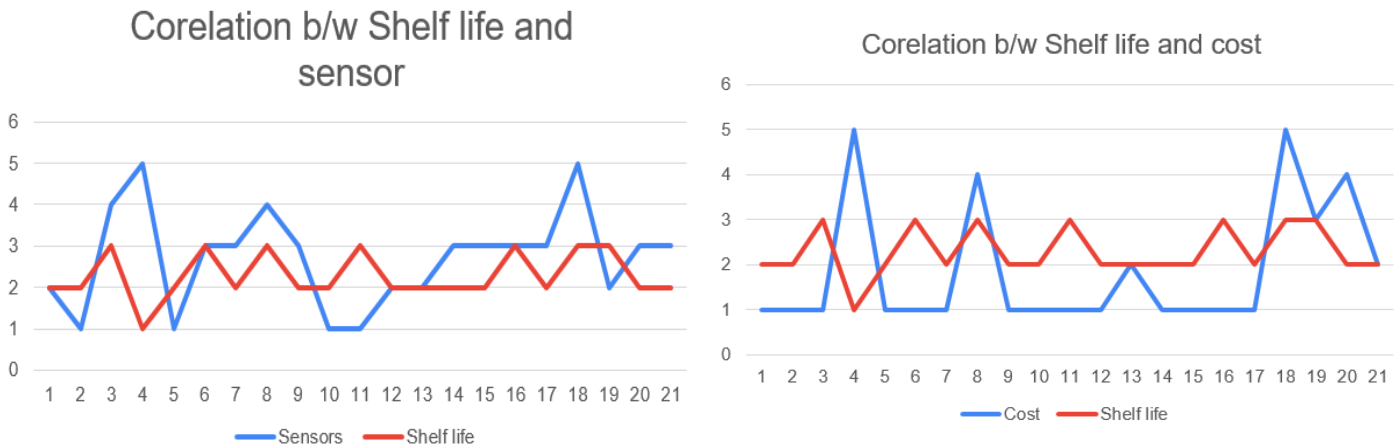


Figure 16: Correlation between independent (delivery time) variable with mediators

METHODOLOGICAL FRAMEWORK

The correlation analysis done in section 3 stresses on the factors that are playing crucial role in the wastages of banana and cherries which indicates packaging as the most important element with the correlation of 0.636480633. The finding further supports the effects of packaging with sensors and cost with the coefficient relation of 0.839243 and 0.676997868 respectively. Based on data analysis below methodological frame work can we evaluated.

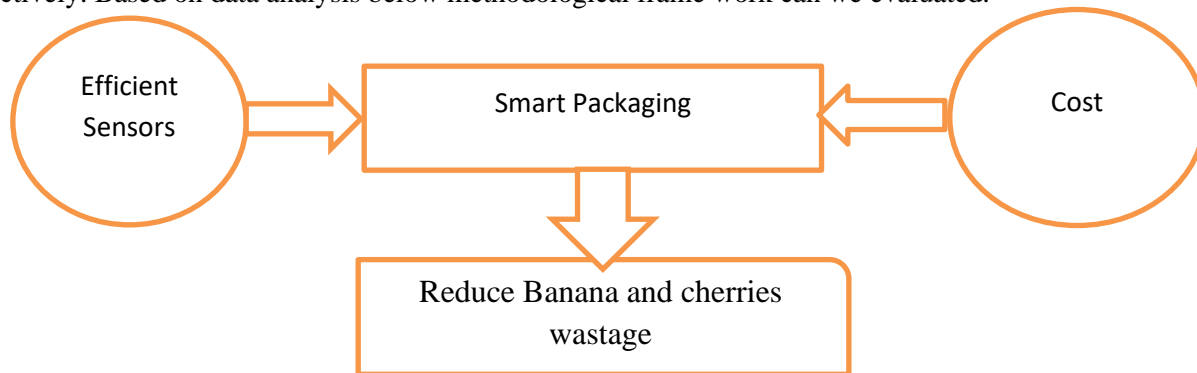


Figure 17: Methodological framework

CONCLUSION

Proposed Solution for smart Packaging

The designs proposed mainly deal with storage and handling of this fruits especially during transit. Special containers with specified number of fruits and their interactions are well explained for reduced fruit interaction and also putting in place new units which can help in easy handling during transportation. The well-known characteristics of these fruits help in the design. Special containers proposed for carrying the cherries are to have the capability of cushioning the fruits to avoid damage of the delicate screen. Bananas on the other hand have their containers accommodate sodium hydroxide and to absorb any carbon IV oxide gas which is as responsible for ripening of bananas as ethylene gas. Sensor will be used to detect the concentration of ethylene in the containers. If the critical value of ethylene concentration is reached, then it will mean that the bananas within that container are ripe. The sensor will sent a notification which will prompt the removal of the bananas since they can longer last long. Inner lining of the container, which will be wool, allows for soaking of sodium hydroxide to absorption of carbon IV oxide in the container. For both fruits, the containers will also have humidity and temperature sensors. Basically, reefer compartments are enormous coolers that are utilized to move temperature-controlled cargoes, for example, organic products, meat, fish, fish, and vegetables, dairy and furthermore additionally non-food items, for example, blossoms, drugs, and film across numerous miles and seas.

Some cargoes may should be sent chilled or frozen or in controlled temperatures. Reefer holders can keep up the load at the necessary temperatures for the term of the travel. Another important point which was observed during survey was sustainable packaging. There is huge market who is willing to pay for green packaging. Therefore, there is a need to find the sustainable packaging solution that makes use of materials and production techniques to save energy and lessen the environmental impact of packaging.

REFERENCES

- Abell, C. (2021). Ripening 101: Climacteric vs. Non-Climacteric Fruits - Food & Nutrition Magazine. Retrieved 3 September 2021, from <https://foodandnutrition.org/blogs/student-scoop/ripening-101-climacteric-vs-non-climacteric-fruits/>
- Abrar ul haq, M., Jali, M. R. M., & Islam, G. M. N. (2019). Household empowerment as the key to eradicate poverty incidence. *Asian Social Work and Policy Review*, 13(1), 4-24.
- Abro, S., Shaikh, S., Abro, R. A., Soomro, S. F., & Malik, H. M. (2020). Aspect Based Sentimental Analysis of Hotel Reviews: A Comparative Study. *Sukkur IBA Journal of Computing and Mathematical Sciences*, 4(1), 11-20.
- Akram, F., Abrar ul Haq, M., and Umrani, W.A., (2019) Assessing the Effect of Managerial Power on Firm Performance through the Perceptual Lens of Executive Remuneration. *Pertanika J. Soc. Sci. & Hum.* 27 (1): 293 – 309
- Akram, F., Abrar ul Haq, M., Natarajan, V. K., & Chellakan, R. S. (2020). Board heterogeneity and corporate performance: An insight beyond agency issues. *Cogent Business & Management*, 7(1), 1809299.
- Avetisyan, s. (2021). Reducing food losses and food waste as the most important problem. *Amberd Bulletin*, (2), 78-84. doi: 10.52174/2579-2989_2021_2_78

- de Gorter, H., Drabik, D., Just, D., Reynolds, C., & Sethi, G. (2021). Analyzing the economics of food loss and waste reductions in a food supply chain. *Food Policy*, 98, 101953. doi: 10.1016/j.foodpol.2020.101953
- Falagán, N., & Terry, L. (2018). Recent Advances in Controlled and Modified Atmosphere of Fresh Produce. *Johnson Matthey Technology Review*, 62(1), 107-117. doi: 10.1595/205651318x696684
- Gane, r. (1936). A study of the respiration of bananas. *New Phytologist*, 35(5), 384-402. doi: 10.1111/j.1469-8137.1936.tb06890.x
- Habib, M., Bhat, M., Dar, B., & Wani, A. (2015). Sweet cherries from farm to table: A review. *Critical Reviews In Food Science And Nutrition*, 57(8), 1638-1649. doi: 10.1080/10408398.2015.1005831
- Haq, M. A. U., Nawaz, M. A., Akram, F., & Natarajan, V. K. (2020). Theoretical Implications of Renewable Energy using Improved Cooking Stoves for Rural Households. *International Journal of Energy Economics and Policy*, 10(5), 546-554.
- How Long Do Bananas Last? Shelf Life, Storage, Expiration. (2021). Retrieved 3 September 2021, from <http://www.eatbydate.com/fruits/fresh/bananas-shelf-life-expiration-date>
- Abdulaziz Alshareef, A. (2012). https://www.kau.edu.sa/Files/320/Researches/61836_32803.pdf. *Journal Of King Abdulaziz University Engineering Sciences*, 23(1), 21-37. doi: 10.4197/eng.23-1.2
- Jedermann, R., Nicometo, M., Uysal, I., & Lang, W. (2014). Reducing food losses by intelligent food logistics. *Philosophical Transactions Of The Royal Society A: Mathematical, Physical And Engineering Sciences*, 372(2017), 20130302. doi: 10.1098/rsta.2013.0302
- Khattak, I. M. S., ul Haq, M. A., Akram, F., & Malik, H. A. (2020, October). Contribution of E-business in Economic Growth of Bahrain. In *2020 International Conference on Data Analytics for Business and Industry: Way Towards a Sustainable Economy (ICDABI)* (pp. 1-6). IEEE.
- Maduwanthi, S., & Marapana, R. (2019). Induced Ripening Agents and Their Effect on Fruit Quality of Banana. *International Journal Of Food Science*, 2019, 1-8. doi: 10.1155/2019/2520179
- Malik, H. A. M., Abid, F., Gilal, A. R., & Raja, A. S. (2017). Use of cloud computing in Hajj crowd management and complex systems. In *2017 4th IEEE International Conference on Engineering Technologies and Applied Sciences (ICETAS)* (pp. 1-5). IEEE.
- Mukama, M., Ambaw, A., & Opara, U. (2020). Advances in design and performance evaluation of fresh fruit ventilated distribution packaging: A review. *Food Packaging And Shelf Life*, 24, 100472. doi: 10.1016/j.fpsl.2020.100472
- Pandemic purchasing: UAE sees largest increase in fresh produce, dairy and baked goods consumption during COVID-19. (2021). Retrieved 3 September 2021, from <https://www.foodnavigator-asia.com/Article/2021/06/02/Pandemic-purchasing-UAE-sees-largest-increase-in-fresh-produce-dairy-and-baked-goods-consumption-during-COVID-19>
- (2021). Retrieved 4 September 2021, from <https://www.emerald.com/insight/content/doi/10.1108/MSGRA-05-2019-0012/full/pdf?title=quality-deterioration-of-bananas-in-the-post-harvest-supply-chain-an-empirical-study>
- Rana, R., Kumar, D. and Prasad, K., 2021. Two warehouse dispatching policies for perishable items with freshness efforts, inflationary conditions and partial backlogging. *Operations Management Research*.
- Siddique, M., Shoaib, S., & Jan, Z. (2020). https://imsciences.edu.pk/files/journals/vol12_2/New%201%20MA.864.pdf. *Business & Economic Review*, 12(2), 19-50. doi: 10.22547/ber/12.2.2
- Ul Haq, M. A., Malik, H. A., Akram, F., & Al Mutawa, E. K. (2020, December). Monetary Benefits of Solar Energy for Smart Cities Development. In *2020 International Conference on Innovation and Intelligence for Informatics, Computing and Technologies (3ICT)* (pp. 1-5). IEEE.
- Verghese, K., Lewis, H., Lockrey, S., & Williams, H. (2015). Packaging's Role in Minimizing Food Loss and Waste Across the Supply Chain. *Packaging Technology And Science*, 28(7), 603-620. doi: 10.1002/pts.2127
- Waste Not Wanted. *Good Fruit Grower*, 29 May 2019, www.goodfruit.com/waste-not-wanted/.
- What do correlation coefficients positive, negative, and zero mean? Steven Nickolas, 2021, <https://www.investopedia.com/ask/answers/032515/what-does-it-mean-if-correlation-coefficient-positive-negative-or-zero.asp>

Impact of Digital Technology and the Need for Periodical Review of Educational Curriculum in Nigeria Tertiary Institutions

Najeem O. Adelakun*

Department of Electrical / Electronic Engineering, The Federal Polytechnic, Ilaro, Ogun State, Nigeria.

Abstract - Effective curriculum is a key determining factor to the growth of the education system in any meaningful societies or nations. It is worthy of note that technology keeps evolving which prompts the need for concurrent review of the curriculum. Presently, there are still outdated topics that ought to have been phased out from the curriculum, it is alarming that some tertiary institutions are still using the old curriculum while those that have adopted the new curriculum have not fully implemented the full content due to the lack of adequate equipment or unavailability of trained personnel. This paper assessed the present state of the Nigerian curriculum, and for better output performance, there should be a recurrent review of the curriculum at most every three years to keep abreast of modern technology. Hence, it was recommended that there should be a recurrent review of the curriculum to meet the trend of economic needs of the nation, training and retraining of lecturers, establishing and equipping all laboratories with modern equipment. Most importantly, those from industries should be part of the team for the formulation of the curriculum to produce competent and qualified graduates.

Keywords: Curriculum review, Education sector, Nigeria education, tertiary institutions.

INTRODUCTION

The emerging trends of digital technology have transformed the education sector globally, this prompts the need for concurrent review of Educational Curriculum in Tertiary Institutions in any meaningful societies or nations. The focus of the educational system globally is to develop a curriculum to meet the present and future challenges of globalisation and the knowledge economy (Craddock, 2017; Dike, 2014). However, the outbreak of COVID-19 has contributed immensely to the adoption of unplanned digital learning by many countries of the world (Adelakun et al., 2020). It is worthy of note that change is the only aphorism that is permanent in life. Consequently, the advancement in technology has made most difficult tasks seamlessly easy and more efficient (Harris et al., 2016; IOM, 2014).

EEF (2019) defines technology as the use of computer and technology-based smart devices to enhance learning within schools. However, digital technology has changed how people communicate, study, and work (Azih and Ejeka, 2015; SRS, 2015), which has transformed the education system from a passive and reactive state to an interactive and dynamic state (Raja and Nagasubramani, 2018). This prompts the need for digital competence for quality assurance and effective delivery (Akram et al., 2021). According to Olofsson et al., (2020), digital competence is divided into four key areas which are: understanding the impact of digitalisation on society, usage and understanding of digital tools and media,

*Corresponding author:

Email: adelakunnajeem@gmail.com (N.O.Adelakun)

iKSP Journal of Computer Science and Engineering (2022) 2(1): 14-19



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

development of a critical and responsible approach, and to improve problem-solving techniques for easy translation of the ideas into action.

Despite recent evolution in the use of digital technology, it is alarming that some tertiary institutions in Nigeria are still using the old curriculum which is based on analogue techniques and outdated topics while those that have adopted the new curriculum have not fully implemented its full content due to lack of adequate equipment or unavailability of trained personnel (Unuoshotse, 2017; Ukata et al., 2017; Abbas et al., 2018). However, Government interest in curriculum development can be dated back to 1882 when the Education Act for Board of Education was established to regulate the development of education at all levels in British West African Countries (Emeh et al., 2011). Consequently, the curriculum is regarded as the heart of any teaching or learning institution (Kranthi, 2017), and can be defined as education policy or set of sequence instructions designed for a specific group of learners to achieve the desired goal within a specific period of time, which straddles the societies from the literate, pre-literate to the illiterate (Alade, 2011; Dhlomo and Mawere, 2020).

Craddock (2017) stated that the number of recognised universities between 1980 and 2017 has grown from 16 to 152. As of April 2021, Nigeria has a total number of three hundred and forty-seven (347) degree-diploma awarding institutions, which comprises 195 universities consisting of (44 Federal universities, 52 State universities, and 99 Private universities). Similarly, with 147 Polytechnics consisting of (38 Federal polytechnics, 48 State Polytechnics, and 61 Private Polytechnics, and the numbers will keep increasing very year (Adelakun, 2021). This led to an increase in the number of graduates on yearly basis and contributed negatively to the rate of unemployment in Nigeria. Consequently, the educational curriculum should be reviewed periodically according to socio-economic conditions of the country to align the students with; employment potentials, abilities to solve problems, improve their decision-making techniques, planning, communication, and presentation skills (Adelakun and Omolola, 2020; Dyjur and Kalu, 2018).

Fundamental Steps to Curriculum Development

The development of an effective curriculum involves a cyclical fundamental step that should be reviewed concurrently. This shows the relationships and interaction of the five key phases of the curriculum development process, each of the key steps are addressed as follows:

- i. **Needs Identification:** The need identification phase is a vital step that lays the foundation for the curriculum development process by which meeting student needs leads to improvement of student learning, which is also known as the discovery phase. This phase identifies key issues/problems/needs and trends that will support the needs assessment. For effective and comprehensive curriculum development the appropriate needs of the target audience must be known and met.
- ii. **Planning:** The planning phase is the stage where the reference of terms is defined. It is at this phase the members of the curriculum development team will be constituted to cut across different sectors such as Professional bodies, statutory bodies, academic planning, researcher, administrative officer among others.

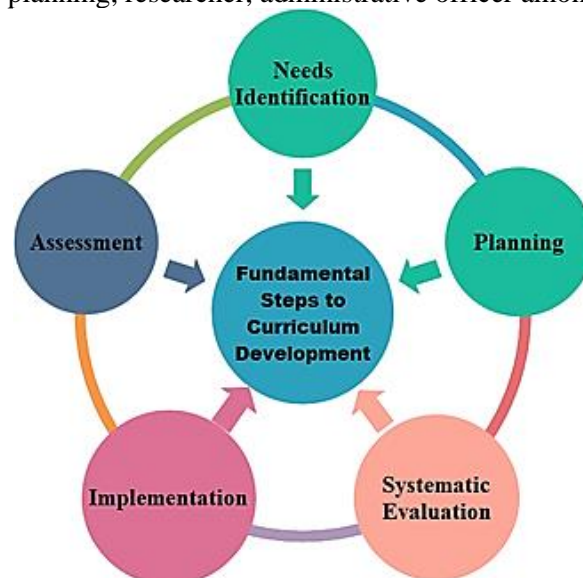


Figure 1: Fundamental Steps to Curriculum Development

- i. **Systematic Evaluation:** This phase deals with the continuous quality assessment based on feedback from key stakeholders and verification of compliance with both internal and external standards and success criteria.
- ii. **Implementation:** This phase can only achieve its goals when the curriculum committee continues to oversee the implementation, updating, and evaluation of the curriculum, by creating workshops/seminars and training for staff to be able to teach newly developed courses with adequate support for effective performance and quality assurance.
- iii. **Assessment:** The curriculum development phase ends and then begins again with a careful assessment of the developed curriculum to ascertain or evaluate if it reflects culture, keeps abreast with digital technology, makes learning consistent, and the impact on socio-economic values to the society.

METHODOLOGY

An online survey was conducted among lecturers of tertiary institutions in Nigeria using descriptive statistic aimed at investigating the impact of digital technology on Nigeria's education curriculum as applicable to various field of studies, and a total of two hundred and twenty responses was gathered from the online survey.

The study aimed to answer the following research questions.

1. Is the curriculum of your department updated in the last five years?
2. Is there a need for a review of the present curriculum?
3. Was the new curriculum fully implemented?
4. Do the lecturers possess the required knowledge to utilize the new curriculum?
5. Was the new curriculum well-structured to meet up with the trend of digital technology?

Which was further classified into two research groups.

Table 1: Research Group A

Research Question	Less than 5 Years	Between 5 to 10 years	Above 10 years
When was the curriculum of your department reviewed last?	58	110	52

Table 2: Research Group B

Research Question	Yes	No
Is there a need for review to the present curriculum?	174	46
Was the new curriculum fully implemented?	130	90
Do the lecturers possess the require skills to utilise the new curriculum?	142	78
Was the new curriculum well-structured to meet up with the trend of digital technology?	188	32

RESULTS AND DISCUSSION

This paper has used an online survey distributed to different lecturers/academia platforms to investigate lecturers view about the present state of Nigeria curriculum as applicable to the different fields of studies in their respective tertiary institutions, and it was observed from the survey conducted that curriculum review durations varies from one department to the other. Table 1 shows that fifty-eight (58) out of the two hundred and twenty (220) respondents said that the curriculum of their departments was last updated less than five (5) years ago, a total of 110 respondents stated that their curriculum was last updated between 5 – 10 years, while 52 out of the 220 respondents stated that their curriculum was updated more than 10 years ago. It can be deduced from Table 1 that majority of the lecturers in tertiary institutions stated that the curriculum of their departments is not reviewed periodically as expected, this shows that some graduates taught will the old curriculum will not be equipped with the appropriate technology needed for the labour market.

Similarly, Table 2 shows that a larger number of lecturers clamoured for the review of the present curriculum, and appreciable numbers of lecturers complained that the available curriculum is not fully implemented, while from those that said the curriculum of their department is updated within the last 5 years agreed that the new curriculum was well structured.

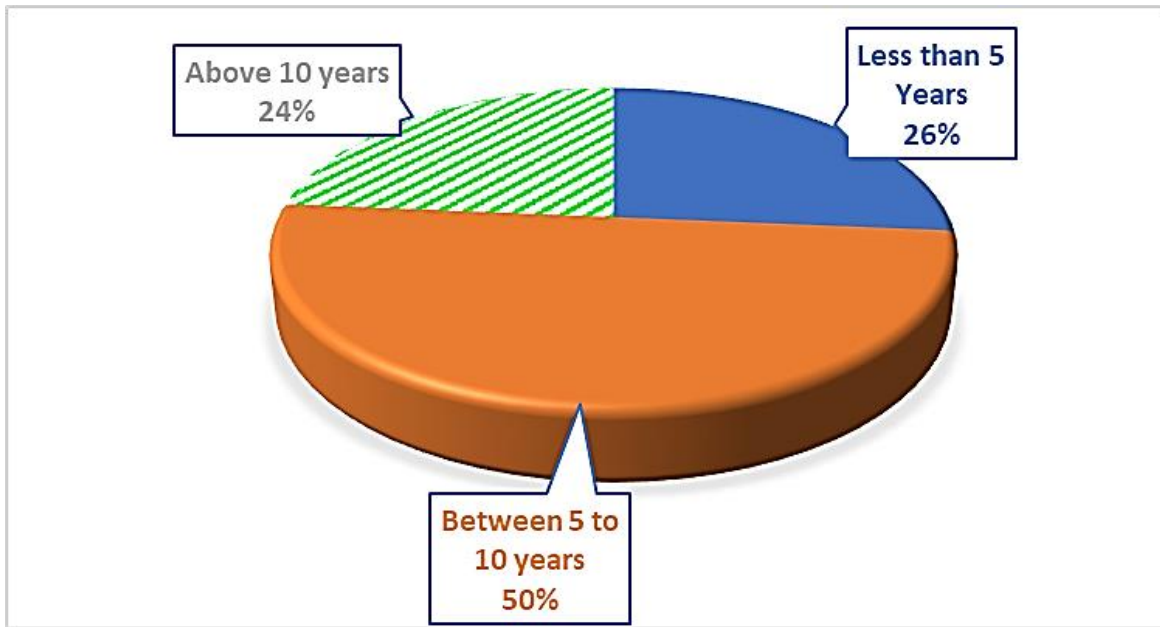
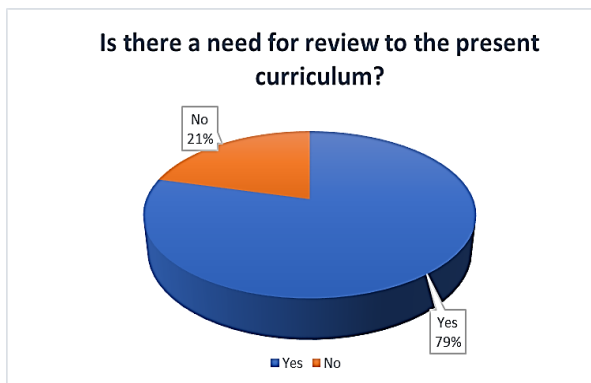
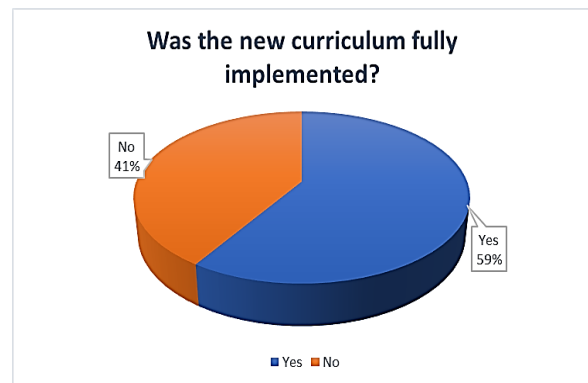


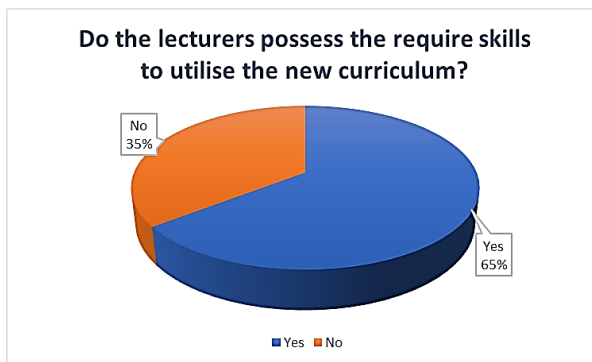
Figure 2: Percentage of Respondents View to Research Question A



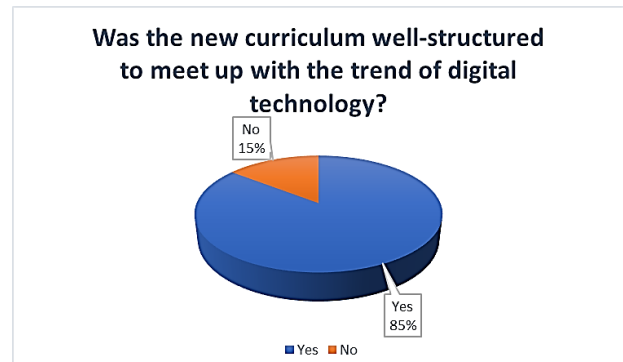
(3a)



(3b)



(3c)



(3d)

Figure 3: Percentage of Respondents View to Research Question B

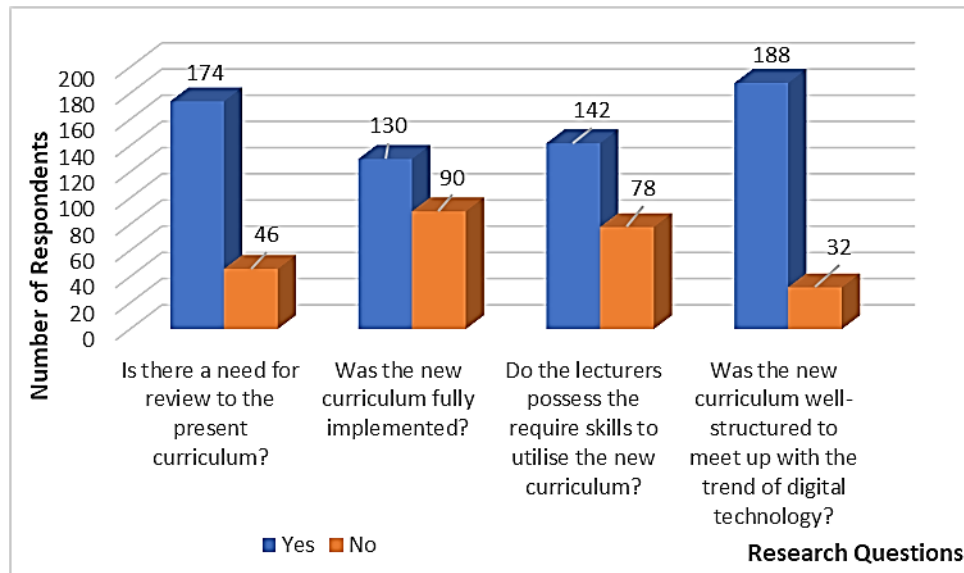


Figure 4: Chart Showing the Respondents View to Research Question B

However, Figure 2 displayed the percentage of respondents views to research question A, 50% of the respondents complained that the curriculum of their department was updated between 5 to 10 years, and 24% of the respondents complained that the curriculum of their departments was last updated more than a decade ago which is detrimental to the quality of output and service delivery, while only 26% of the respondents stated that the curriculum of their departments was updated less than 5 years ago, but it is worthy of note that the time frame between the old and new curriculum review is longer than expected. Similarly, figure 3 displayed the percentage of respondents' views to research question B, where 79% of respondents clamoured for the review of the present curriculum, and 41% of the respondents complained that the curriculum available is not fully implemented, this will affect a larger percentage of the students taught will outdated curriculum, also 65% of the respondents agreed that the lecturers possesses the required skills to implement the new curriculum and 35% of the respondents disagreed with it, and suggested training and re-training for the personnel for effective delivery, while 85% of the respondents with updated curriculum stated that the curriculum of their departments was well structured to meet up with digital technology and only 15% with updated curriculum complained that the curriculum did not match up with the latest trend in digital technology.

Figure 4 displayed the chart of respondents view with the exact numbers of respondents view to each research question as shown in Table 2, it was observed that 174 out of the 220 responses clamoured for the review of the present curriculum, 90 out of the 220 responses complained that the curriculum available is not fully implemented which can be from one or more of the following reasons such as sophisticated equipment/tools, lack of technical personnel to implement the contents of the curriculum, and 142 out of the 220 agreed that lecturers possesses the required skills to utilise the new curriculum, while a larger number of respondents of about 188 out of the 220 with updated curriculum stated that the new curriculum was well structured to meet up with the trend of digital technology.

CONCLUSION

It is evident that a periodical review of the educational curriculum in tertiary institutions in Nigeria is essential irrespective of field/department of study due to the evolving digital technology and also to keep abreast of the emerging technology. Consequently, digital technology is the heartbeat of development and progress, but can be hindered if the following factors are not well addressed: lack of technical personnel to implement the contents of the curriculum, training and retraining of lecturers, establishing and equipping all laboratories with modern equipment, which will equip the students with appropriate technical employability skills after graduation. Most importantly, there should be a synergy between Academia-Industrial personnel in the curriculum formulation for effective and robust curriculum development, and also there should be monitoring and sanction for anyone tertiary institutions deviating from the minimum standard of laboratories, equipment, and facilities and staffing.

REFERENCES

- Abbas, N., Ashiq, U., & Abrar ul haq, M. (2018). Gap between acquired and required English learning objectives for the primary school students: Empirical evidence from Sargodha (Pakistan). *Cogent Social Sciences*, 4(1), 1457421.
- Adelakun, N. O. and Omolola, S. A. (2020). A Pragmatic Study on E-Learning System for Higher Education in Developing Countries. *Proceedings of the 1st National Conference*, 14–20.
- Adelakun, N. O., Omolola, S. A. and Oloruko-Oba, A. A. (2020). The Impact of COVID-19 On Education System in Nigeria During and After the Pandemic: An Engineering Perspective. *Paper Presented at 1st Multidisciplinary International Conference on Open & Distance Learning and Digital Transformation*.
- Adelakun, N. O. (2021). Present State of Tertiary Institutions in Nigeria. *Mendeley Data*, VI,. <https://doi.org/10.17632/4c8vv5h42j.1>
- Alade, I. A. (2011). Trends and Issues on Curriculum Review in Nigeria and the Need for Paradigm Shift in Educational Practice. *Journal of Emerging Trends in Educational Research and Policy Studies*, 2(5), 325–333.
- Akram, F., Haq, M. A. U., Malik, H. A., & Mahmood, N. (2021, September). Effectiveness of Online Teaching during COVID-19. In *2021 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT)* (pp. 568-573). IEEE.
- Azih, N. and Ejeka, C. A. (2015). A Critical Analysis of National Board For Technical Education Old And New Curriculum In Office Technology And Management For Sustainable Development. *British Journal of Education*, 3(9), 41–50.
- Craddock, A. (2017). Education in Nigeria International Mobility Trends : the Top African Sender of Students. *WENR Education in Nigeria*, 03, 1–23. <https://wenr.wes.org/2017/03/education-in-nigeria>
- Dhlomo, T. and Mawere, P. (2020). Curriculum reform in Zimbabwe : An analysis of early childhood development centers ' state of readiness to embrace the new curriculum. *Journal of African Studies and Development Full*, 12(3), 104–114. <https://doi.org/10.5897/JASD2019.0566>
- Dike, S. (2014). Opening Remarks Presented at the Train-the – Trainers Workshop on the Use of the Revised 9-Year Basic Education Curriculum. *Held at Rockview Hotel, Abuja Nigeria*, 5- 9th August.
- Dyjur, P. and Kalu, F. (2018). Introduction to curriculum review. In *Taylor Institute for Teaching and Learning Calgary*. University of Calgary.
- EEF. (2019). Digital technology. *Education Endowment Foundation*. <https://educationendowmentfoundation.org.uk/>
- Emeh, J. U., Isangadighi, A. J., Asuquo, P., Agba, I. K. and Ogaboh, A. M. (2011). Curriculum Review: Reactions from Education Stakeholders in South-South States of Nigeria. *Global Journal of Human Social Science*, 11(2).
- Harris, J. L., Al-bataineh, M. T. and Al-bataineh, A. (2016). One to One Technology and its Effect on Student Academic Achievement and Motivation. *Contemporary Educational Technology*, 7(4), 368–381.
- IOM. (2014). Needs Assessment In The Nigerian Education Sector International Organization For Migration, Abuja, Nigeria. May.
- Kranthi, K. (2017). Curriculum Development, *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 22(2), Ver. III, 01-05. <https://doi.org/10.9790/0837-2202030105>
- Olofsson, A. D, Fransson, G. and Lindberg, J. O. (2020). A study of the use of digital technology and its conditions with a view to understanding what ‘adequate digital competence’ may mean in a national policy initiative, *Educational Studies*, 46 (6), 727–743, <https://doi.org/10.1080/03055698.2019.1651694>
- Raja, R. and Nagasubramani, P. C. (2018) Impact of modern technology in education, *Journal of Applied and Advanced Research*, 3(Suppl. 1) S33-S35, <https://dx.doi.org/10.21839/jaar.2018.v3S1.165>
- SRS. (2015). Literature Review on the Impact of Digital Technology on Learning and Teaching. In *Social Research Series*. ICF Consulting Services Ltd.
- Ukata, P. F., Nmehielle, E. L., & Silas-Dikibo, I. D. (2017). Assessment of Regular Development and Implementation of OTM Curriculum in the South-South Polytechnics as a Strategy to Submerge Nigeria's Economic Challenges. *International Journal of Education and Evaluation*, 3(4), 1–11.
- Unueshotse, B. F. (2017). Needs analysis of the writing skills of HND Business Studies students at Auchi Polytechnic, Auchi Edo State. *International Journal of English and Literature*, 8(August), 74–87. <https://doi.org/10.5897/IJEL2017.1040>

Opportunistic Cooperative Relaying Protocol for UAV-assisted Flying Adhoc Network

Muhammad Nauman Bashir*¹, Kamaludin Mohamad Yusof¹

¹ School of Electrical Engineering, Faculty of Engineering, University Technology Malaysia, Johor, Malaysia

Abstract - A tremendous rise in the use of Unmanned Aerial Vehicles (UAVs) in wireless communication is recently observed. Due to the useful features of UAVs, a new era of over-the-head wireless communication is finding its space at a rapid pace. A range of civilian and military applications is being tested using such UAV-assisted Flying Ad-hoc Networks. In such networks, the quality of communication is usually affected due to fading on channels and limited resources of the UAVs. In this work, we study the outage performance of dual-hop network over Rayleigh fading air-to-ground channels between source UAV and destination Ground Control Station and a group of intermediate UAV aerial relays. We focus on spatial diversity using cooperative relaying through relaying UAVs working in a cooperative manner to support the communication using maximum ratio combining at the destination. The best relay may be selected based on channel state information in terms of signal-to-noise ratio to make the system resource efficient. UAVs are assumed to work in Amplify and Forward mode in Half Duplexed downlink communication scenarios while deriving the closed-form expression for the outage probability. Numerical results are validated using Monte Carlo Simulations to study the impact of various system parameters on performance. The results of proposed non-buffer aided scheme is compared with compulsory direct-only communication. The impact of number of intermediate relays on dual hop links, symmetric and asymmetric channels is studied. The results are compared by changing the data rate and SNR of the links. The results show that cooperative relaying decreases the outage probability. More relays in cooperation, improve the system performance but at the cost of the network increased resources.

Keywords: Flying Ad-hoc Network, Dual-hop, System Outage Probability, Spatial Diversity, Cooperative Relaying, Relay Selection

INTRODUCTION

The Unmanned Aerial Vehicles (UAVs) assisted Flying Ad-hoc Networks (FANETs) are becoming popular in a range of applications like remote sensing, search and rescue operations, traffic monitoring, disaster management, wildlife surveillance, agriculture and communication network expansions, etc. FANETs can disseminate target area observations through multi-hop relayed communication however; these applications demand quality and reliability in operation. The small UAVs in such networks can provide Line of Sight (LoS) communication up to a range of 75 m. Single cluster FANET has its own limitations while Multi-Cluster FANET provides better efficient network management at a reduced cost of communication. Due to typical issues of UAVs, ensuring the quality of service (QoS) in such networks is challenging. Usually UAVs in FANET move at higher speeds of 30-460 km/hr. (İlker Bekmezci, 2013) due to which the network topology is intermittent having fluctuating channel conditions.

*Corresponding author:

Email: bashir-1977@graduate.utm.my (M.N. Bashir), Email: kamalmy@fke.utm.my (K.M. Yusof)

iKSP Journal of Computer Science and Engineering (2022) 2(1): 20-26



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Due to mobility of the UAVs, topology of FANET is dynamic and it is a challenging task to design an efficient data routing protocol for such networks. The selection of channel fading model depends on environment of deployment. The large-scale channel models capture the channel behaviour in terms of effects like path loss and environment of propagation over larger distances, while small-scale models capture the fast-fading effects due to multipath propagation and variations in received signal due to noise and short distances (Waqas et al., 2017). The small-scale channel models are based on stochastic processes and can be mathematically explained by probability density functions (PDFs) and cumulative distribution functions (CDFs). To improve the performance of such system sound mathematical modelling of the system links and efficient data routing schemes are required.

Various studies on improving the system performance of UAV-assisted FANETs have been reported. The authors (Yanmaz, 2021) studied about a team of UAVs for search and rescue missions and worked on decreasing the number of drones by using static relay positioning techniques. The authors (Bodanese, Araújo, Steup, Raffo, & Becker, 2014) presented a communication scenario using IEEE 802.15.4 UAV transceiver enhancing the protocol by introducing an adaptation layer between network and data link layer. The work (Cetin & Zagli, 2011) used IEEE 802.11 MAC for a FANET performing tasks of data collection and delivery among UAVs. The study (Jawhar, Mohamed, Al-Jaroodi, & Zhang, 2013) presented a communication scheme based on UAV as a node between ground nodes and a sink limiting the range of communication of the ground nodes using IEEE 802.11 MAC.

Authors (Zhan, Yu, & Swindlehurst, 2011) studied a system using UAVs as relays between Ground Control Station (GCS) and mobile units (MUs) and using controlled heading angles to study the system performance. The FANET system outage probability was investigated by (Kim & Lee, 2018) for A2G communication considering the co-channel interferences for both line of sight (LoS) and non-LoS (NLoS) links. The outage probability of the FANET of UAVs with energy harvesting capability was studied by (Yang, Chen, Hasna, & Yang, 2018) by modelling the shadowed rice distribution. Using Rician Shadowed Environment, the outage probability for hybrid duplexed UAVs system is studied by (Ernest, Madhukumar, Sirigina, & Krishna, 2019). The work (Goddemeier & Wietfeld, 2015) evaluated IEEE 802.11 links at 2.4GHz using the Rician faded channels to account for flight altitude multipath effects while the work (Wu, Kumar, & Davari, 2005) analysed BER of 802.11a OFDM signals at 5GHz. The symbol error rate and channel capacity as performance parameters were studied (Chen, Hu, Zhu, Zhong, & Chen, 2018) considering both multipath and the shadowing effects (Malik, 2021).

The performance parameters like throughput, delay, symbol error rate and outage probability needs investigation in such networks considering both direct and indirect communication links. In this work, we consider a dual-hop cooperative relay network of UAVs in Amplify and Forward (AF) mode (Jiang & Schotten, 2021) and study their outage performance over Rayleigh fading channels considering the UAVs exchange their data with each other. Next section II, provides the system model in our considered scenario as a general model. The instantaneous end-to-end Signal to Noise Ratio (SNR) expressions for AF relaying are obtained and closed-form expressions for the system outage probability are derived. An upper bound on the end-to-end SNR is used as a high SNR regime. Section III provides performance analysis by formulating the problem. The results of Monte Carlo Simulations for the system outage probability to study the impact of various system parameters on performance are discussed in Section IV while Section V concludes the discussion.

SYSTEM MODEL

Assume a scenario where low altitude single antenna type UAVs are communicating in an urban environment to observe the target area. The shadowing is causing fading between nodes due to the high-rise obstacles of the urban environment assuming the shadowing or large-scale fading is present along with double scattered propagation. Assume that direct and indirect paths are available among source UAV and destination GCS in presence of possible K, UAV relays in this UAV-assisted FANET as depicted in figure 1.

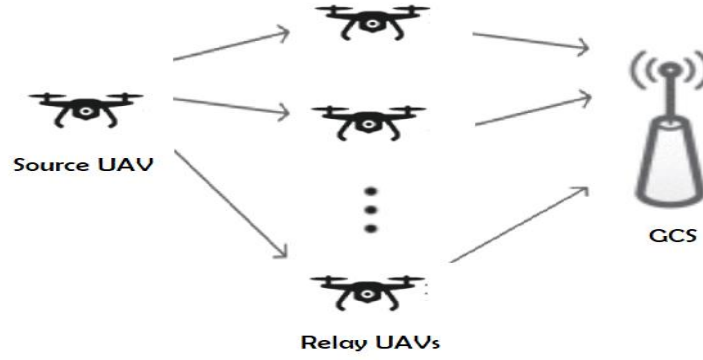


Figure 1: Dual Hop Relay Network of UAVs

The cooperative UAV relay nodes between source and destination provide a means of spatial diversity and pass on the signals over Rayleigh fading channels on dual-hop links assuming UAVs fly at lower altitudes in urban environment. The UAVs are assumed to work in HD fashion and AF mode. The source transmits data that is received by destination and the available relays while relays amplify it and send it to the destination. The source UAV and destination GCS are assumed to calculate transfer probabilities among the available nodes on regular intervals. They use physically distributed opportunistic approach considering their inter-node distance, load, information rate and channel conditions in a non-buffer aiding fashion. The Channel State Information (CSI) is subject to channel variations, however to simplify the analysis, we assume that the CSI remains stationary during a specific time step.

PROBLEM FORMULATION AND PERFORMANCE ANALYSIS

We assume that UAV relays, available between source UAV and destination GCS for the UAVs-assisted FANET communication system, are working in two phases. During first time-slot, source sends a symbol to destination and relays. The destination GCS receives the signal in first time-slot, analyses the signal on direct link from source to destination and if link's SNR is above the threshold value ($\gamma_{th} = 2^{r_o} - 1$ where r_o is the data rate on links), it continues with direct transmissions. Once the γ_{SD} falls below γ_{th} , the destination node takes help of the available relays to take part in communication and performs cooperative relaying while destination GCS performs MRC to sum up all signals as per Incremental Relaying (IR) approach. The direct signal received by relay nodes and destination node can be expressed mathematically as

$$y_{N_{SRk}} = E_s x_s h_{SRk} + n_{SRk} \quad (1)$$

$$y_{N_{SD}} = E_s x_s h_{SD} + n_{SD} \quad (2)$$

Here x_s represents the symbol transmitted on first-hop by source and E_s is the average energy of the transmitted signal. Here h_{SD} and h_{SRk} are the direct channel gains from source to destination and relays which are affected by AWGN as $n_{SD} \sim CN(0, N_o)$ with zero mean and N_o variance on source to destination link and $n_{SRk} \sim CN(0, N_o)$ with zero mean and N_o variance on source to relay links respectively. In the second time-slot, the relays amplify and forward the data to the destination as

$$y_{N_{RkD}} = G_{SRk} h_{RkD} y_{N_{SRk}} + n_{RkD} = G_{SRk} h_{RkD} (E_s x_s h_{SRk} + n_{SRk}) + n_{RkD} \quad (3)$$

Here the term G_{SRk} is the gain capability of a k^{th} relay working in AF mode and is defined as $G_{SRk} = \frac{E_s}{E_s |h_{SRk}|^2 + N_o}$. In this expression, E_s is the average energy per symbol, h_{RkD} are the direct channel gains from relays to destination, which are affected by AWGN as $n_{RkD} \sim CN(0, N_o)$ with zero mean and N_o variance. After performing maximum ratio combining (MRC) at the destination node, the signal can be expressed as

$$y_D = y_{N_{SD}} + y_{N_{RkD}} \quad (4)$$

Assuming that all available relays do contribute in cooperative relaying, the instantaneous SNR can be expressed as

$$\gamma_D = \gamma_{SD} + \gamma_{SRkD} = \gamma_{SD} + \sum_{i=1}^K \frac{\gamma_{SRk} \cdot \gamma_{RkD}}{1 + \gamma_{SRk} + \gamma_{RkD}} \quad (5)$$

In this expression, the indicated instantaneous SNRs of various links may be defined as $\gamma_{SD} = \frac{E_s|h_{SD}|^2}{N_o}$, $\gamma_{SRk} = \frac{E_s|h_{SRk}|^2}{N_o}$, and $\gamma_{RkD} = \frac{E_s|h_{RkD}|^2}{N_o}$. As per our considered application scenario, Rayleigh fading is selected on the links for whom, the PDF and CDF of the SNR are defined as $f_{\gamma v}(\gamma) = \frac{1}{\bar{\gamma}} e^{-\frac{\gamma}{\bar{\gamma}}}$ and $F_{\gamma v}(\gamma) = 1 - e^{-\frac{\gamma}{\bar{\gamma}}}$. Now assuming upper bound on the total end-to-end SNR to simplify the analysis as

$$\gamma_k \geq \frac{\gamma_{SRk} \cdot \gamma_{RkD}}{1 + \gamma_{SRk} + \gamma_{RkD}} \quad (6)$$

Now the end-to-end SNR after MRC can be expressed as

$$\gamma_D = \gamma_{SD} + \gamma_k \quad (7)$$

In our considered scenario, a best link with a best available relay may be selected to optimize the network resources. This selection can be based on CSI in terms of SNR. Let R_k is a set of available relays and γ_k is the associated SNR of the k^{th} relay, then SNR of the best selected relay in this set will be

$$\gamma_{SRk} = \max_{k \in R_k} \{\gamma_k\} \quad (8)$$

The PDF and CDF of the link SNR in this case can be expressed as $f_{\gamma sr}(\gamma) = K f_k(\gamma) [F_{\gamma k}(\gamma)]^{K-1}$ and $F_{\gamma sk}(\gamma) = [F_{\gamma k}(\gamma)]^K$ respectively. Now if $\gamma_D < \gamma_{th}$, this situation leads to an event that the communication is not happening. This situation is termed as outage and the probability of outage may be defined in terms of channel capacity. Let c is the channel capacity and if data rate (R) is more than the capacity, situation is termed as outage, as

$$P_{out} = P_r(c < R) \quad (9)$$

That means the total SNR has fallen below γ_{th} . For single relay, outage probability can be expressed as

$$P_{out} = \int_0^{\gamma_{th}} f_{\gamma}(\gamma) d\gamma = \int_0^{\gamma_{th}} \frac{1}{\bar{\gamma}} e^{-\frac{\gamma}{\bar{\gamma}}} d\gamma \quad (10)$$

and for the case that if K relays are available and all relays do contribute in the cooperative relaying, the outage probability can be expressed as

$$\begin{aligned} P_{out} &= \int_0^{\gamma_{th}} K f_k(\gamma) [F_{\gamma k}(\gamma)]^{K-1} d\gamma \\ &= 1 + \sum_{n=1}^K \binom{K}{n} \frac{n(-1)^{n-1}}{\bar{\gamma}_c - n\bar{\gamma}_{SD}} \left[\bar{\gamma}_{SD} e^{-\frac{\gamma_{th}}{\bar{\gamma}_{SD}}} - \frac{\gamma_c}{n} e^{-\frac{n\gamma_{th}}{\bar{\gamma}_c}} \right] \end{aligned} \quad (11)$$

Let $\rho_i = \bar{\gamma}_{SRk} = \bar{\gamma}_{RkD}$ is the average channel's SNR on either hop of the relay link, then c is inverse of ρ_i by taking $m=1$ in expression of Nakagami- m fading for Rayleigh fading case. All available relays can support the communication, however this model is using more resources that makes it resource inefficient. The destination node can select one best relay looking at the channel conditions to make the system more resource efficient as

$$S_{Rk} = \arg \max_{k \in R_k} \{\gamma_k\} \quad (12)$$

This selection of a best relay is the case to better utilize the resources as only one relay with best conditions is to be used to relay the signal from source UAV to destination GCS.

RESULTS DISCUSSION

The system performance is studied in terms of outage probability in various settings of the considered system model. Monte Carlo Simulations are used to study the impact of various system parameters and to validate the analytical results of the previous section. Figure 2 demonstrates the impact of Cooperative Relaying (CR) on system performance. The performance of CR using intermediate relays shown by dash graphs is much better compared to direct transmission only between source UAV and the destination GCS ignoring relays shown by solid graph. The relays if considered reduce the outage probability considerably. For this study, the relays count is considered 1 and 2 with the option of relays to cooperate with. For analysis purposes, the data rate is fixed at $r = 2$ b/s/h. Figure 3 shows a study of the system outage probability for the two data rates as $r = 1$ corresponding to SNR threshold of 3 and $r = 3$ corresponding to SNR threshold of 61. Solid graphs show lower data rates and dashed graphs show high data rates with various numbers of

intermediate relays as $K=1, 2$, and 3 . Results demonstrate that system performance drops at high data rates that confirm the theoretical concepts. On increasing the number of intermediate relays and assuming all relays contribute to the CR, it is observed the outage probability drops and system performance improves. This is due to the fact that there is more chance of successful transmissions.

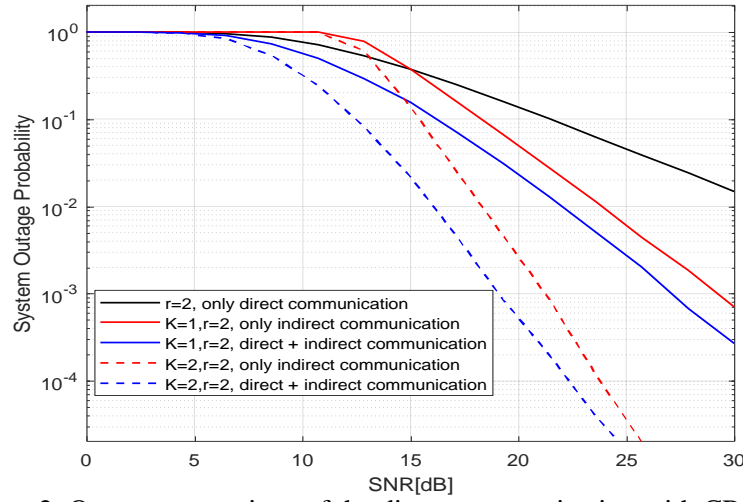


Figure 2: Outage comparison of the direct communication with CR System

Figure 4 compares the same setting but considering that a best relay is selected out of available ones and only the selected relay contributes to CR. The data rate is varied to have the study.

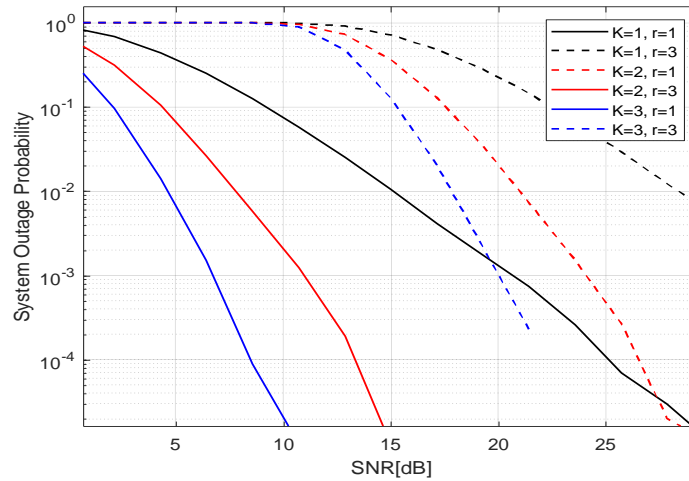


Figure 3: Outage comparison of the CR System with all relays contributing

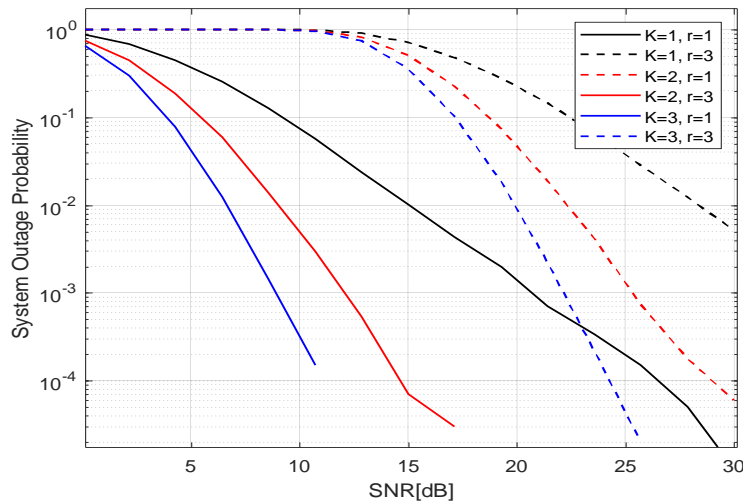


Figure 4: Outage comparison of the CR System with best relay contributing

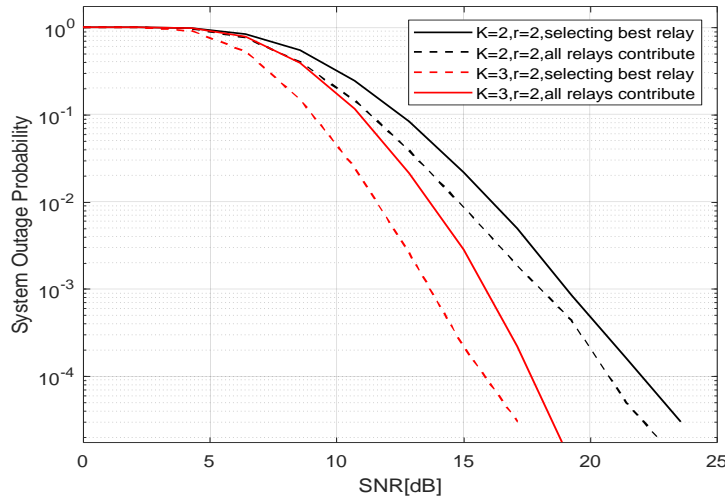


Figure 5: Outage comparison of the CR System with best selected relay and as all relays are contributing

Figure 5 demonstrates a comparison of system performance in conditions that all available relays contribute to CR and when only selected relay contributes providing exact difference. The results are in conformance with previous results that if all relays contribute the outage probability falls improving the system performance. For this study, available relays are considered two, and the data rate is fixed at two. Figure 6 demonstrates the impact of symmetric and asymmetric channels on indirect dual-hop communication. For this study direct link is assumed absent due to heavy shadowing and fading considering the source and destination are far apart. Number of intermediated relays and data rate for this study is considered 2. Results show that a slight improvement is observed in asymmetric cases. This is due to the fact that, asymmetric channels provide relays an option to select suitable packets from the buffer and to take few decisions regarding transmitting to improve the system performance.

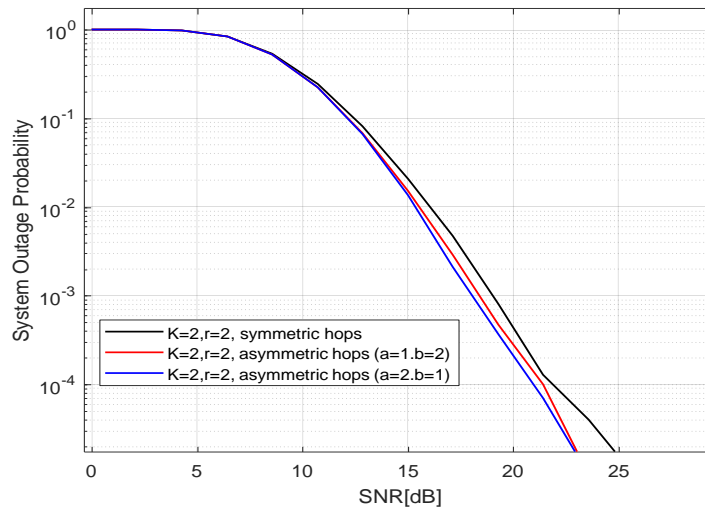


Figure 6: Outage comparison of the dual-hop System with symmetric and asymmetric channels

CONCLUSIONS

In this paper, the performance of the cooperative multi-relay dual-hop UAV-assisted FANET working in AF mode in a downlink scenario is studied over the Rayleigh fading channel affected by AWGN. UAVs have limited powers and limited flight duration that makes the FANET intermittent. General analytical expressions for the end-to-end SNR and the outage probability are derived as a measure of system reliability considering the system taking the opportunity of neighbourhood relays. Opportunistic network formation using available UAVs with sufficient energy can ensure continuous operation of the network. The numerical results are validated using Monte Carlo Simulations that demonstrate that channels working at lower data rates and using cooperative relaying through intermediate relays perform better. Selecting a relay with the best channel conditions improves the system performance and saves the resources. In our study best relay selection is done using the CSI in a non-buffer aided communication scenarios. The

asymmetric dual-hop links improve the system performance and provide the option to handle the relay buffer in a better way. In the future, we intend to select the best relay using buffer status conditions in buffer aided network and compare the results with CSI based relay selection scheme for both SISO and MIMO based dual-hop links and with DF type of relays.

REFERENCES

- Bodanese, J., Araújo, G. d., Steup, C., Raffo, G., & Becker, L. (2014). Wireless Communication Infrastructure for a Short-Range Unmanned Aerial. 28th Int. Conf. Adv. Inf. Netw. Appl. Work., IEEE, 2014: pp. 492–497.
- Cetin, O., & Zagli, I. (2011). Continuous airborne communication relay approach using unmanned aerial vehicles. *J. Intell. Robot. Syst.* 65 (2011), 65, 549–562.
- Chen, X., Hu, X., Zhu, Q., Zhong, W., & Chen, B. (2018). Channel modeling and performance analysis for UAV relay systems. *China Communications*, 15(12), 89–97.
- Ernest, T. Z., Madhukumar, A. S., Sirigina, R. P., & Krishna, A. K. (2019). A power series approach for hybrid-duplex UAV communication systems under Rician shadowed fading. *IEEE Access*, 7, 76 949–76 966.
- Goddemeier, N., & Wietfeld, C. (2015). Investigation of air-to-air channel characteristics and a UAV specific extension to the Rice model. *IEEE Globecom Workshops (GC Wkshps)*.
- İlker Bekmezci, O. K. (2013). Flying Ad-Hoc Networks (FANETs): A survey,. *ISSN 1570-8705, Volume 11(3)*, 1254-1270.
- Jawhar, I., Mohamed, N., Al-Jaroodi, J., & Zhang, S. (2013). A framework for using unmanned aerial vehicles for data collection in linear wireless sensor networks. *J. Intell. Robot. Syst.*, 74, 437–453.
- Jiang, W., & Schotten, H. D. (2021). Predictive Relay Selection: A Cooperative Diversity Scheme Using Deep Learning. *IEEE Wireless Communications and Networking Conference (WCNC)*.
- Kim, M., & Lee, J. (2018). Outage probability of UAV communications in the presence of interference. *IEEE Global Communications Conference*, Dec 2018.
- Malik, H. A. M. (2021). Complex network formation and analysis of online social media systems. *Cmes-Computer Modeling In Engineering & Sciences*.
- Waqas, A., Malik, H. A. M., Karbasi, M., Nawaz, N. A., & Mahessar, A. W. (2017). CLOUDSIS: An Application of Cloud Computing for Smart School Management System. *University of Sindh Journal of Information and Communication Technology*, 1(1), 35-38.
- Wu, Z., Kumar, H., & Davari, A. (2005). Performance evaluation of OFDM transmission in UAV wireless communication. *Thirty-Seventh Southeastern Symposium on System Theory*.
- Yang, L., Chen, J., Hasna, M. O., & Yang, H.-C. (2018). Outage performance of UAV-assisted relaying systems with RF energy harvesting. *IEEE Commun. Lett.*, 22(12), 2471–2474.
- Yanmaz, E. (2021). Dynamic Relay Selection and Positioning for Cooperative UAV Networks. *IEEE Networking Letters*, 3(3), 114-118.
- Zhan, P., Yu, K., & Swindlehurst, A. L. (2011). Wireless relay communications with unmanned aerial vehicles: Performance and optimization. *IEEE Trans. Aerosp. Electron. Syst.*, 47(3), 2068–2085.

Heat Stroke Prevention Wearable Based in Internet of Things (IOT)

Fariza Zahari*, Sangheeta Maniran, Kumudhini Devi Arul Selvam, Indumathi Ganason,

Politeknik Sultan Salahuddin Abdul Aziz Shah, Selangor, Malaysia

Abstract - This study is to introduce the development of a new alerting system for parents about children exposure to risk related to heat stroke. The smart heat stroke detector was created with the intention of measuring the internal temperature of the human body, which is closely linked to cases of heat stroke. Heat stroke is caused by the body overheating, which usually occurs as a result of being exposed to or exerting physical effort in high temperatures. Usually, the foremost genuine of warm damage and warm stroke and can happen in case the body temperature rises to 40 °C (104 F) or higher. The methodology adopted for this sub project is implementing the Internet of Things (IoT) system and embedding the interface hardware into smartphone system software. This device connects to the network provider to display information the device gathers from the environment through sensors. A gateway enables cloud services to be accessed by devices that are not directly linked to the Internet. The results obtained undeniably implicit that the body temperature increased significantly when children too expose to the environment. Thus, the importance of this device evaluated through lecturers, parents and students perspectives was 90% respectively. The resulting system was also low in power and cost, non - invasive, and provided real time monitoring. It is also easy to use and provides accurate measurements. In conclusion, the study of this proposal will assist in the reduction of heatstroke among potential children in the near future in Malaysia.

Keywords: Heat Stroke Detector, Internet of Things, smartphone, temperature

INTRODUCTION

Heatstroke may be a condition caused by your body overheating, as a rule as a result of drawn out presentation or physical effort to high temperatures. This most serious form of heat injury, heatstroke, can occur if your body temperature rises to 40 °C (104 F) or higher. Heatstroke need immediate medical attention. Untreated heatstroke can rapidly harm your brain, heart, kidneys, and muscles. The damage decreases as treatment is delayed, increasing the risk of real complications or death. Side effects of a hot flash include high body temperature, mental status, or changed behavior. Heatstroke can cause confusion, agitation, slurred speech, irritability, delirium, seizures, and coma. Sweating pattern changes. The skin will feel hot and dry to the touch in heatstroke caused by hot weather. Heatstroke caused by hard activity, on the other hand, might cause skin to feel dry or slightly damp. One of the symptoms is nausea and vomiting. That person may feel sick to stomach. Heart rate and breathing rate also increases. Cases of heat stroke spike at the end of June into July each year and continue through August. Director of Pediatric Sports Medicine, Troy Smurwa at the Children's Health Andrews Institute for Orthopaedics and Sports Medicine, says that heat stroke in children can be extremely serious. The Health Ministry recorded 14 heat-related illnesses from March 1 until today due to the recent heat wave phenomenon. Health Minister Datuk Seri Dr S. Subramaniam, 2016 said the cases comprised 11 heat exhaustion and 3 heat stroke cases. This study examined the medical records of three children who were entrapped inside

*Corresponding author:

Email: farizahari80@gmail.com (F. Zahari)

iKSP Journal of Computer Science and Engineering (2022) 2(1): 27-33



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

cars and analyzes their outcomes following the accidents. Following the accidents, the children got heat stroke and survived a coma for many days, but with serious cognitive damage. Two of the children were diagnosed with hyperactivity and attention deficit disorder, while the third was diagnosed with active epilepsy. Heat stroke caused by vehicular entrapment is one of the most avoidable brain injuries in children. Every year, a number of children are entrapped in cars or other vehicles, leaving survivors with substantial brain injury.

RESEARCH RELATED WORK

Heatstroke
Heatstroke is a medical emergency symbolized by a high body temperature, altered mental status and, in classical heat stroke, hot, dry flushes skin. Heat stroke could start to multi-organ damage with haemorrhage and necrosis in the lungs, heart, liver, kidney, brain and gut (Subudhi et al., 2012). Heat stroke occurs when the core body temperature hiked against a failing thermoregulatory system (Leon et al., 2010).

Thermoregulatory

Thermoregulatory homeostasis, while devoted to by multiple mechanisms, is basically controlled by the core temperature of the human body. The body must carry out automatic regulatory measures in order to maintain homeostasis, grant it to stay within the safe ranges of human temperature (Leon et al., 2010)

Heat stress

During exercise in the heat, the temperature gradient between the body core and the skin narrows, and for thermoregulatory purposes skin blood flow must therefore increase (Arifwidodo & Chandrasiri, 2020).

Effects of heat stroke

The body's surface temperature rises as a result of these processes. When this scenario persists for an extended period of time, sweating causes dehydration, which, when paired with blood retention at dilated peripheral blood arteries, causes blood volume to drop (Subudhi et al., 2012). The body's surface temperature rises as a result of activities. When this situation continues for a long time, the dehydration caused by sweating progresses and, when combined with blood being retained at the dilated peripheral blood vessels, blood volume decreases (Epstein & Yanovich, 2019).

Factors of heatstroke

Danger can exist, but it isn't necessary. Patients may feel a prodrome of debility, headache, coldness, lack of full control of physical motions, and nausea in the early stages of heat stroke. It can also cause chest pain, breathing difficulties, and abdominal pain. Thirst isn't a good predictor of severe heat stroke. The body's temperature rises quickly, perspiration stops, and several systems fail. The transition from warm depletion to warm stroke causes an acute stage inflammatory reaction. During heat stroke fever the temperature is increased 104°F equal to 40 °C or more. Sweating usually stops and the skin becomes heated and dry. Misfortune of awareness is followed by perplexity, incoherence, and ataxia. Seizures are common in some patients, and they usually happen when they cool down. Important symptom alterations include tachycardia and hyperventilation. An rise in haematocrit (a precursor to haemoconcentration), electrolyte and acid-base abnormalities (usually metabolic acidosis, hypokalaemia, and hyponatremia), and indications of muscle, kidney, and liver damage were discovered during a laboratory evaluation. Myocardial damage can be detected by an ECG and cardiac enzymes. If disseminated intravascular coagulation has occurred, thrombocytopenia can be severe (Epstein & Yanovich, 2019).

Heat stroke: classic and exertional

Classic heat stroke happens as a result of over the top natural temperatures, and basically influences individuals of helpless populations, such as children or the elderly, those as of now in destitute wellbeing, or those who don't have the conditioning. Classic heat stroke is characterized by little or no sweating due to over dehydration (Grogan & Hopkins, 2002). Exertional heatstroke is caused by the generation of abundance warmth within the body and is more common among generally healthy people such as athletes and others who do an energetic activity out of doors. The capacity to sweat may not be impeded, but the individual is incapable to cool down rapidly sufficient after the ceasing of activities. This heat-related variation of sickness can happen quickly at moderately direct temperatures amid strenuous movement. (Fischer et al., 2012).

Benefits of heatstroke wrist band

The rising temperature on the earth's surface has had a substantial impact on human health in recent years, with the idea of heat stroke becoming a concerning problem, especially given the rise in deaths due by this illness. The impacts of high-temperature difficulties have piqued the interest of researchers, who believe that technology may play a key part in solving these challenges. The research illustrates the construction of a system that uses temperature sensors and the Internet of Things to identify heat stroke in children early. The findings suggest that the proposed approach is effective and feasible in real life.

Concept of Internet of Things

A recent study reported that Internet of Things links people, device and services[8]. Furthermore, Internet of Things more likely to describe as a system or framework. Internet of Things known as connection between network of things or objects and Internet. Internet of Things consist of two words. That are Internet and Things. Internet depicts network that are linked world widely via some standard protocols. Moreover, The Things shows that any physical objects which has connectivity (Pawan, 2018; Waqas et al., 2017). Based on Cisco statistics nearly 50 billion devices will be communicated to the Internet by 2020 (Ryan, 2017). This turns IoT to become reality. The Internet of Things is gathering in importance with rising access to the Internet (Farooq et al., 2019).

Impact of Internet of Things

Internet of Things has a higher effect on certain sectors. That are education, business ,science ,communication ,humanity and government (Angelova et al., 2017). It also proven that this service helps the community by reducing costs , increasing efficiency and enhancing the usability of existing systems (Angelova et al., 2017). Some evidence proves that by using Internet of Things objects identify themselves and gain intelligence behaviour by allowing related decisions thinks to fact that they can communicate information about themselves. Market Analyst determined that IoT devices would reach 25 billion by 2020 (Pawan Singh, 2018). IoT devices will collecting a very big amount of data on the way people communicate between each other (Angelova et al., 2017).

Internet of Things Standardizations and Protocols

It was estimated that by 2020 around 50 to 100 billion things will be connected electronically to Internet (Zeinab Kamal Aldein Mohammad & Elmustafa Sayed Ali Ahmad, 2017). The Internet of Things' victory is based on standardisation, which ensures interoperability, compatibility, reliability, and efficient operations on a global scale, with more than 60 companies working with standards such as the IETF, IEEE, and ITU to define new IP-based technologies for the Internet of Things.

IoT and Health care Monitoring

Health care one of the biggest sectors in Internet of Things technology. IoT wearable device monitor patient health related blood pressure and body temperature (Saha et al., 2019). Health care sector uses smart health sensors to analyse and collect data using gateways and analyse through cloud and stores in clouds (Saha et al., 2019).

Cloud Computing

It was certified that cloud computing can analyse and stores data effectively. The cloud is the most convenient and cost-effective way to deal with IoT data, and it opens up new possibilities for data aggregation, integration, and exchange with third parties (Sadiku & Musa, 2014; Xian, 2017). Based on findings, Internet of Things platform need to be contributed by a powerful computing sources. Therefore, cloud computing is suitable for the development for Internet of Things platform.

Benefits of Using Internet of Things in Health Care System

In the health care and medical science, some of the main applications of the Internet of Things includes technological advancement in medical control of medications and equipment's, telemedicine and mobile health care along with personal medical management, health data management and etc (Malik et al., 2017). IoT could have various applications in medical industry for improving the quality of life, saving lives and reduce treatment cost. There are several benefits of using Internet of Things in Health Care System such as:

Reduction in Human Error

Data can be collected very accurately and precisely using various physiological medical sensor. It's can minimise human error in taken reading (Singh, 2018).

Early Detection of Chronic Disease

Using Big data analytics, it is possible to predict chronic disorder in early stage and treatment can be done within short period.

Obstacles without Alert System for Heat stroke

The effects of job stress are one of the reasons most people tend to forget (Ferrara et al., 2013). This clarifies that a person's daily life can affect their driving skills and contribute to their decision to leave their child alone in the vehicle due to stress and workload.

Visual Alert

Based on International Journal of Engineering and Computer Science in visual alert (Rubasri, Aravind, Valan, 2015). ODAS provides visual alert to the user by means blinking LED lights. Similar to audible alert, the frequency of blinking depends upon vehicle speed above threshold limit. But in our project research we are using Virtuino Software which is an Android app for monitoring sensors or control electrical devices via Bluetooth, local WiFi or Internet.

Working and ThingSpeak Setup.

ThingSpeak is an excellent tool for IoT-based Arduino projects. We can monitor our data over the Internet from

anywhere by utilising the Channels and websites supplied by ThingSpeak, and we can also operate our system over the Internet by using the Channels and webpages offered by ThingSpeak. ThingSpeak 'Collects' data from sensors, analyses and visualises it, and then 'Acts' by initiating a reaction.

Android App Based on IoT

Doctors and patients have distinct login passwords. Doctors may monitor the health state of all patients allocated to them, while patients can only check their own health condition by joining in with their own login credentials, and humidity status can be accessed by both doctors and patients using an Android app based on IoT in smart phones.

MATERIAL AND METHODS

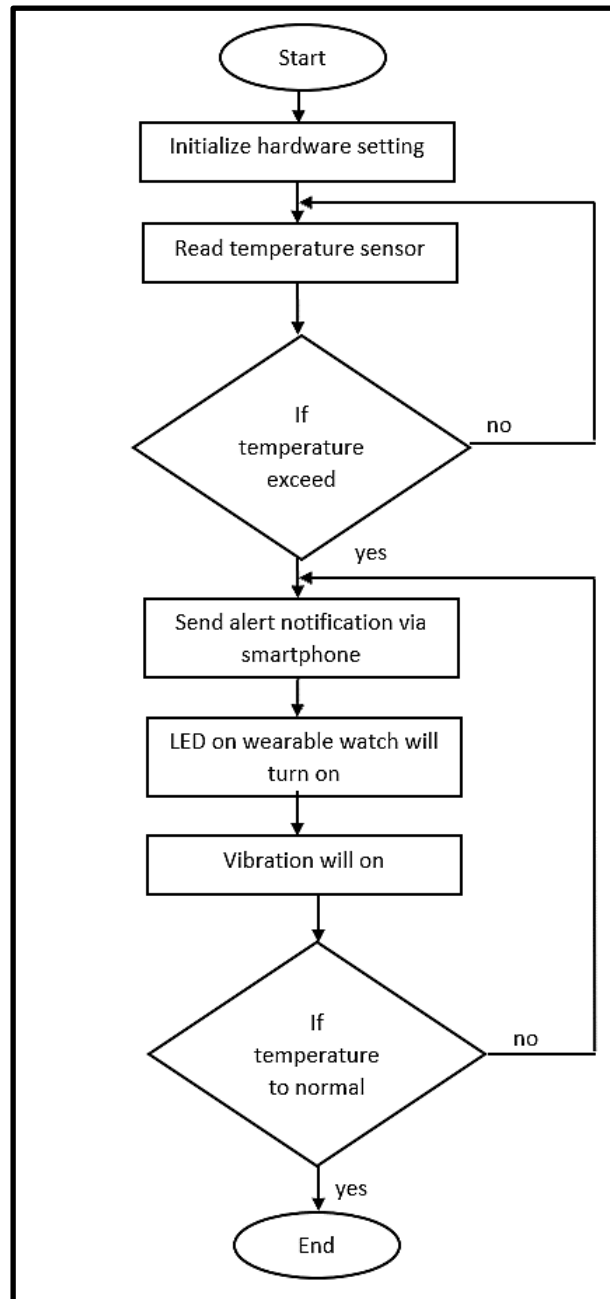


Figure 1: Methodology

The methodology adopted for this sub project is by using smart phone and Apps .The app is based on IoT software. This software is going to be a connection between the wearable device and the application in smart phone. When the switch is ON, sensor will start measuring temperature in human body. If the voltage increases, then the temperature rises and there is a voltage drop between the transistor terminals of base and emitter, they are recorded by the sensor. If the temperature maintain on normal level, it will continue monitor the temperature. Once the temperature exceeds 38.5°C , a notification will be send to the parents smart phone using IoT. An LED will turn ON in the wearable watch by child if the temperature rise. Parents can monitor their child's body temperature in their Blynk Android App. **Blynk** is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. Once the parent press the alert button in the application, the vibration in the watch will stop. The device would keep on vibrating if the user(child) neglect to consume water. The reading of temperature will be shown on LCD display which help the user to read. If there is no changes in the temperature level, it will keep vibrating until action is taken. Once the temperature level come back to normal, LED and vibration will stop alarm.

RESULTS AND DISCUSSIONS

The research was carried out within predetermined period of time. It is necessary that each of the data found has a solution. Analysis of data will also show every study conducted either successfully achieve the objectives set out or not. Add on, a market survey conducted during the research was carried out. A survey was conducted in public areas such as supermarket, schools, and public areas. As a result of the analysis made, it is known that the resulting study is a success or failure. There are three questions will be asking to public:

- 1) Do you think heat stroke is ongoing problem among children?
- 2) Do you think we need to create a device to alert parents about the children internal temperature?
- 3) Is there any IoT device that can monitor heat stroke temperature in the market?

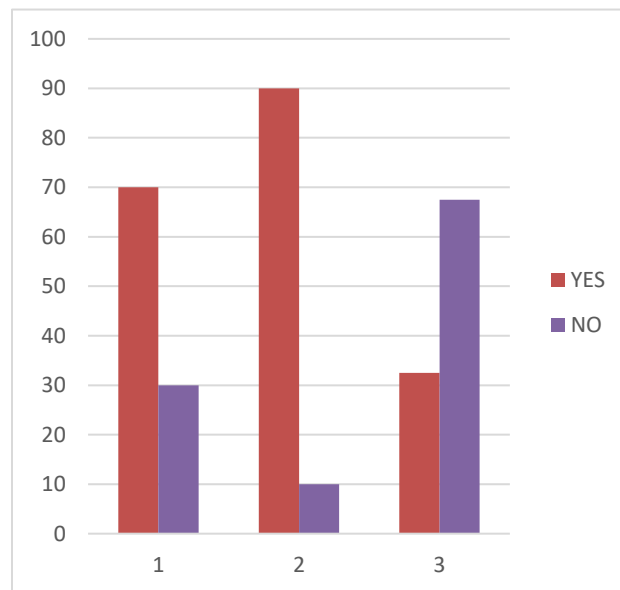


Figure 2: Market Survey

From the Figure 2, majority of them aware that heat stroke is a on going problem on children. According to the Centers for Disease Control and Prevention, children are more vulnerable to heat-related diseases because they have less body surface area to control their temperatures. Younger children are more susceptible to heat exhaustion due to a lack of sweating space and a lack of regulating capability. Children are also unable to regulate their body temperature on their own. Humidity and thirst also play a part. When the humidity level in the surroundings is more than 60%, children have a tougher time cooling down since their sweating mechanism doesn't operate as effectively.

In addition, 90% of them agreed to create a device to alert parents about the children internal temperature. According to No Heatstroke.org, 760 children have died of heatstroke in cars since 1998. In over half of the cases, the child was left in the vehicle by accident. According to the website, nearly 74% of the deaths have been in children ages 2 and younger. More than half the time the child is forgotten by a caregiver. Most of the parents need a device to alert them regarding their children temperature. Furthermore, it will be easier for them to monitor the temperature. Hopefully this will prevent heat stroke cases in the future. Furthermore, 67.5% of them said there was no IoT gadget that could monitor

or warn the body temperature in the market. However, companion gadgets have greater potential, at least in terms of financial impact and return on investment, in business environments. Within healthcare there is worried about the encounters that clients do not have at the bedside, but also in waiting rooms, crisis rooms and commercial workplaces. Healthcare organizations are also at the forefront of IoT, with 55% of them having fairly strong agreements. In healthcare, audio gadgets and feature phones are the most used basic gadgets, according to 46% of respondents in the division. The majority, 57%, also employ visual analytics to improve their levels of customer service and patient care. Iot device will help to reduce number of heat stroke patients and will help parents to monitor children temperature using real time data.

CONCLUSION

From this project, it got to encourage the self-expression of thoughts and and feelings related with illness/hospitalization. And also, help patient process and work through traumatic experiences associated with hospitalization. Next to facility positive self-esteem and positive body image, and promote a sense of independence and feelings of control. Encourage the development of healthy strategies for coping with hospitalization. The main result of this project is to help to measure the temperature to prevent heatstroke among children. Most of the rehab process is depends on feeling of patient and judgement by doctor. Sometimes the judgement could be wrong. With this project it got to resolve this problem and give an accurate rehab level things to patient. The resulting system was also low in power and cost, non - invasive, and provided real time monitoring. It is also easy to use and provides accurate measurements.

REFERENCES

- Angelova, N., Kiryakova, G., & Yordanova, L. (2017). THE GREAT IMPACT OF INTERNET OF THINGS ON BUSINESS. *Trakia Journal of Sciences*, 15, 406–412. <https://doi.org/10.15547/tjs.2017.s.01.068>
- Arifwidodo, S. D., & Chandrasiri, O. (2020). Urban heat stress and human health in Bangkok, Thailand. *Environmental Research*, 185(March). <https://doi.org/10.1016/j.envres.2020.109398>
- Damian Ryan(2017).Understanding digital marketing:marketing strategies for engaging the digital generation.New York: Kogan Page Ltd.345-362.
- Epstein, Y., & Yanovich, R. (2019). Heatstroke. *New England Journal of Medicine*, 380(25), 2449–2459. <https://doi.org/10.1056/NEJMRA1810762>
- Farooq, M. ., Muhammad Wassem, M., Sadia Mazhar, S., Anjum Khairi, K., & Talha Kamal, T. (2019). A review on internet of things. *Proceedings of the International Conference on Intelligent Sustainable Systems, ICISS 2019*, 113(1), 479–484. <https://doi.org/10.1109/ISS1.2019.8908105>
- Fischer, E. M., Oleson, K. W., & Lawrence, D. M. (2012). Contrasting urban and rural heat stress responses to climate change. *Geophysical Research Letters*, 39(3). <https://doi.org/10.1029/2011GL050576>
- H.Grogan and P.M. Hopkins(2002) heat stroke :implication for critical care and anaesthesia academic unit of Anasthesia, St James’s University Hospital page 700-704
- Leon, L. R., Gordon, C. J., Helwig, B. G., Rufolo, D. M., & Blaha, M. D. (2010). Thermoregulatory, behavioral, and metabolic responses to heatstroke in a conscious mouse model. *American Journal of Physiology - Regulatory Integrative and Comparative Physiology*, 299(1). <https://doi.org/10.1152/AJPREGU.00309.2009>
- Malik, H. A. M., Abid, F., Wahiddin, M. R., & Bhatti, Z. (2017). Robustness of dengue complex network under targeted versus random attack. *Complexity*, 2017.
- Pawan Singh (2018).Internet of Things based Health Monitoring System :Opportunities and Challenges.International Journal of Advanced Research in Computer Science.Volume 9 (1) : 224-228.
- P. Ferrara, F. Vena, O. Caporale, V. Del Volgo,P.Liberatore, F. Ianniello, A. Chiaretti and R. Riccardi.2013. Children left unattended in parked vehicles: a focus on recent italian cases and a review of literature.Ital. J. Pediatr. 39(1): 71.
- R.Rubasri , D.Aravind , M.Valan Rajkumar (2015).Stimulation of Health Care Monitoring System in Internet of Things By Using RFID. International Journal of Engineering and Computer Science.Volume 7 : 23592-23970.
- Sadiku, M. N. O., & Musa, S. M. (2014). *Cloud computing: Opportunities and challenges* ©. 34–36.
- Saha, G., Singh, R., & Saini, S. (2019). A Survey Paper on the impact of “Internet of Things” in Healthcare. *Proceedings of the 3rd International Conference on Electronics and Communication and Aerospace Technology, ICECA 2019*, 331–334. <https://doi.org/10.1109/ICECA.2019.8822225>
- Singh, P. (2018). INTERNET OF THINGS BASED HEALTH MONITORING SYSTEM : OPPORTUNITIES AND CHALLENGES Study and Design of Routing Protocols for Health Monitoring through Vehicular Ad-hoc Network View project INTERNET OF THINGS BASED HEALTH MONITORING SYSTEM : OPPORTUNITIES AN. *International Journal of Advanced Research in Computer Science*, 9(1). <https://doi.org/10.26483/ijarcs.v9i1.5308>

- Subudhi, A. W., Askew, E. W., & Luetkemeier, M. J. (2012). Dehydration. *Encyclopedia of Human Nutrition*, 2–4, 1–9. <https://doi.org/10.1016/B978-0-12-375083-9.00068-4>
- Waqas, A., Malik, H. A. M., Karbasi, M., Nawaz, N. A., & Mahessar, A. W. (2017). CLOUDSIS: An Application of Cloud Computing for Smart School Management System. *University of Sindh Journal of Information and Communication Technology*, 1(1), 35-38.
- Xian, K. (2017). *Internet of Things Online Monitoring System Based on Cloud Computing*. <https://doi.org/10.3991/ijoe.v13i09.7591>
- Zeinab Kamal Aldein Mohammed and Elmustafa Sayed Ali Ahmed (2017). Internet of Things Applications, Challenges and Related Future Technologies. *World Scientific News*. 67 (2) : 126-148

ALICE Pattern Matching Based Chatbot for Natural Language Communication: System Development and Testing

**Munaveer Karimeni Peedikayil Tharammal^{*1}, Muhammad Nauman Bashir¹,
Kamaludin Mohamed Bin Yusof², Sameera Iqbal³**

¹Department of Electronics and Communications Engineering, Middle East College, Muscat, Oman

²School of Electrical Engineering, Faculty of Engineering, University Technology Malaysia, Johor

³Higher College of Technology

Abstract - The simulation of human processes using Artificial Intelligence (AI) features is finding place in various fields including the e-learning environment. Chatbot system using text and voice, recognizing images, analyzing the sentiments, and generating natural language is latest utility based on AI concepts. The chatbot systems are becoming more common due to their benefits as a support mechanism helping human beings in their day to day tasks. This project aimed at developing and testing a chatbot system to communicate with the education sector users using natural language through android based application creating a smart education environment. The project developed an online chatting platform using Artificial Linguistic Internet Computer Entity (ALICE) Pattern Matching techniques where students could communicate related to their learning activities such as submission deadline of the reports and assignments, student's information, co-curricular and extracurricular activities. The system design uses a Raspberry Pi 3 which works as Transmission Control Protocol (TCP) server and uses three different types of pattern matching techniques which are keyword detection, symbolic reduction, and synonyms resolution. An android user interface application is also designed which works as TCP client. The system design uses a database for student information system in the Python server. The obtained results are in voice and text format from the android user interface application and are displayed on Python Interpreter. The developed project system can enhance the student engagement in learning activities. This system can also help teachers in saving their time and to support them to utilize their class timings for other co-curricular activities like synchronous and asynchronous activities to support active learning and flipped learning. The proposed system has the potential to test and analyze various factors as use of technology, student learning including impact of student engagements in their learning activities.

Keywords: e-Learning; ALICE Pattern Matching; chatbot; AI in Education; Smart Education

INTRODUCTION

In recent years, Artificial Intelligent (AI) systems are one of the advanced technologies which are being used in the field of education, healthcare, industries, etc. Artificial Intelligent systems can simulate the human brain processes using machines (Tim, 2019). These systems are intelligent as humans, so they can interact or communicate with humans through texts or voices. In Tim's article (2019) entitled 'Can a computer fool you into thinking it is human?' published in BBC News states that the chatbots are now present everywhere and handling a large number of complaints and inquiries. Recognitions of images and speech, chatbots, sentiment analysis, and generation of natural language are the applications of AI. AI-based chatbot systems are used for performing day to day tasks, like home automation and

*Corresponding author:

Email: munaveer00@gmail.com (M.K.P. Tharammal), mbashir@mec.edu.om (M.N. Bashir), kamalmy@utm.my (K.M.B. Yusof), sameeraiqbal786@hotmail.com (S. Iqbal)

iKSP Journal of Computer Science and Engineering (2022) 2(1): 34-42



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

transportation, etc. The chatbot system is a software program or application which communicates with the users using natural language through an android mobile application (Tim, 2019).

In education sector, if the chatbot system is introduced for the students they can know about the due dates of all online report submission for the subjects and their overall education progress and performances. Also, it may help to find information on important events such as exams and extracurricular activities just by interacting with the developed chatbot system. Thus, the developed chatbot system can enhance engagement in all subjects and learning process. The developed chatbot system is powered by Python Transmission Control Protocol (TCP) server and uses three different types of pattern matching techniques which are keyword detection, symbolic reduction, and synonyms resolution. The developer designed and developed an android based mobile application for enabling the use of a chatbot system and a database for student information system in the Python server. The rest of the paper is categorized as follows:

The 2nd section of this paper explores the related work. The 3rd section discusses the methodology applied in order to execute the proposed system. The 4th section reviews the results obtained while the 5th section sums up the results of this project followed by acknowledgment and references.

RELATED WORK

Over the past few years, extensive research on the above-while working on the project objectives, a range of literature were reviewed. The authors Diwanji et al. (2018) proposed a chatbot system for flipped classroom settings where the data were collected through many types of research finding their strength. Moreover, they discussed many features that could offer by the chatbot system and how useful is a chatbot system for the modern world, but they lack on providing information on the implementation of the chatbot systems. There is a need to research based on the implementation of the chatbot system instead of researching how chatbot systems would be useful. The authors Hajare et al. (2018) proposed a chatbot system for education that could provide information for the study content asked by the user from an external source or local database, but the popular chatbot systems (Siri, Alexa, Ok Google, etc.) available now are also being used by the students for acquiring information on any type of study content asked by the user and are free of cost.

Although, the proposed chatbot system by Hajare et al. (2018) does not link to any other application in educational fields. And the most popular chatbots (Siri, Alexa, etc.) can deliver information to the user for any study contents from the internet and will invalidate the proposed chatbot system. The authors Naveen et al. (2016) proposed a chatbot system for visually impaired people where the system lacks security for the application and needs an authentication procedure using their mobile number or email address. The research article entitled 'Chatbot based College Information System' by Ram (2019) proposed a chatbot system for the college information system to provide student information by linking with Facebook accounts. However, there is a lack of security as hackers can steal college/institutional data by hacking Facebook accounts hence, a chatbot system without linking social media accounts of the user should be developed.

METHODOLOGY

This research work was supposed to successfully develop a small-scale chatbot system for an educational institute like Middle East College in Oman. The first step of the project was the requirement analysis phase. The product requirements and specification analysis phase were the next step where the complete specification of the project system was analyzed with the help of visuals, block diagrams, schematic diagrams, and flow charts available from the literature. The architecture or high-level design was the next step which defines how the project system should perform the functions and fulfill the design. The design work is divided into various functional sub-blocks to determine the working capability of the project system altogether. The details of the design phase define the delivery of algorithms for each architectural component. Each of the sub-blocks were joined to form a modular design.

The production, operation, and maintenance phase dealt with the enhancements and corrections. The system acceptance testing phase inspects the entire software system and how they are going to perform in the project environment. The integration testing phase checked the modules whether they are interconnected correctly or not. The unit testing phase checked the working of the modules as expected. The coding phase converted the module design into codes and transformed the algorithm, data structures, and programming codes into the required project system. The unit testing, integration testing, system testing, and acceptance testing were considered in the validation phase where the proposed project system was validated through these testing stages.

Our designed system works as TCP server and client connection. The Raspberry Pi 3 (RPI 3) acts as TCP server and the android application acts as TCP client. Users can send the inputs to the RPI 3 using the android user interface application through the same Wi-Fi network. The Raspberry Pi 3 requires a Raspbian Operating System (OS) installed on a Secure Digital (SD) card. RPI 3 boots up Raspbian OS from the SD card and will be opened with desktop idle. It is required to connect to a wi-fi router which provides internet connection and it requires Python idle ver-2.7.16 programming tool for programming the server codes. The android based user interface application can be designed using the App Inventor

Designer tool and App Inventor Block Editor Tool in MIT app inventor 2 online platform. MIT app inventor 2 is a free online platform for building android based user interface applications.

App Inventor Designer tool is used for selecting the components required for the application and App Inventor Block Editor tool is used for assembling the program blocks that specify how the components should work or behave. After designing the application, it is possible to create a stand-alone android application which can be installed on any android phones. By default, it will save the application in .apk format. To initialize the user interface application, it is required to install the designed application on an android device. Also, it is required to connect to the same wi-fi router in which the server is connected. Wi-fi router requires to provide internet connection for the server and the client. The user interface application is required to initiate TCP socket connection by using the server's IP address and port number for the working of chatbot system.

Raspberry Pi 3 used to develop the chatbot system works as Python Transmission Control Protocol (TCP) server. RPi 3 generates a server socket when it starts. Socket is said to be as an end point of two-way communication link between two different programs running on a network and goes on wait mode after initializing the server and client connection. A socket connection will be created by the client using server Internet Protocol (IP) address and port number, it tries to establish a communication link with the server. RPi 3 will wait for a service request from the client. Usually, the waiting of the server is said to be as "listening" for an incoming client. Generally, the TCP works with the IP address which explains how the computers send data packets to each other. The server receives the input data in text format sent by the user and then server processes it. The server sends back the output data in text format to the client. The datasheets which shows the working specifications and functionalities for Raspberry pi 3 are available.

Wi-fi router is used to provide internet connection for TCP server and client to transmit the data between them and the actual data transfer between the server and client is performed using Internet Protocol (IP). It is important to use the client socket extension while designing the chatbot system user interface in MIT app inventor 2. The connection will not be possible if the user interface application is developed using a damaged client socket extension component or without client socket extension. The input parameters for working of the project system are the wi-fi router which provides internet connection for both server and client, android based user interface application and server.

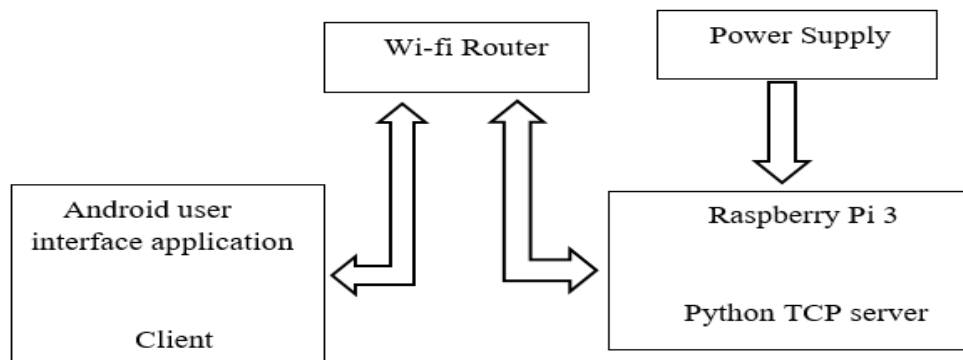


Figure 1: System Block Diagram

The figure 1 shows the system block diagram. Raspberry Pi 3 works as the TCP server powered by Python which processes the input and provides the output data through Wi-fi. Raspberry Pi 3 and android application are connected to the same Wi-Fi router which provides internet. In our design, the Python TCP server, client, and Wi-fi routers are the three major elements involved in the chatbot system development. The System Raspberry Pi 3 works as a Python TCP server. The android based user interface application works as a client and is developed using MIT app inventor. The Python TCP server is developed using Python idle ver-2.7.16 programming software. Raspberry Pi 3 is powered ON via a 5V power supply. The android based user interface application is used to send input data as voice or text format to the server. The processed data is then sent back to the user as output and is displayed on the user interface application also output is read aloud by Text to speech engine following the flow chart illustrated in fig.2. Our chatbot system follows ALICE algorithm and works using three different pattern matching techniques.

- Keyword Reduction Technique

The chatbot system provides the result according to the keywords present in the query.

- Synonym resolution technique

The chatbot system returns the same output for various queries asked by the user with the similar synonyms.

- Symbolic reduction technique

This technique is used to reduce the complexity queries asked by the user.

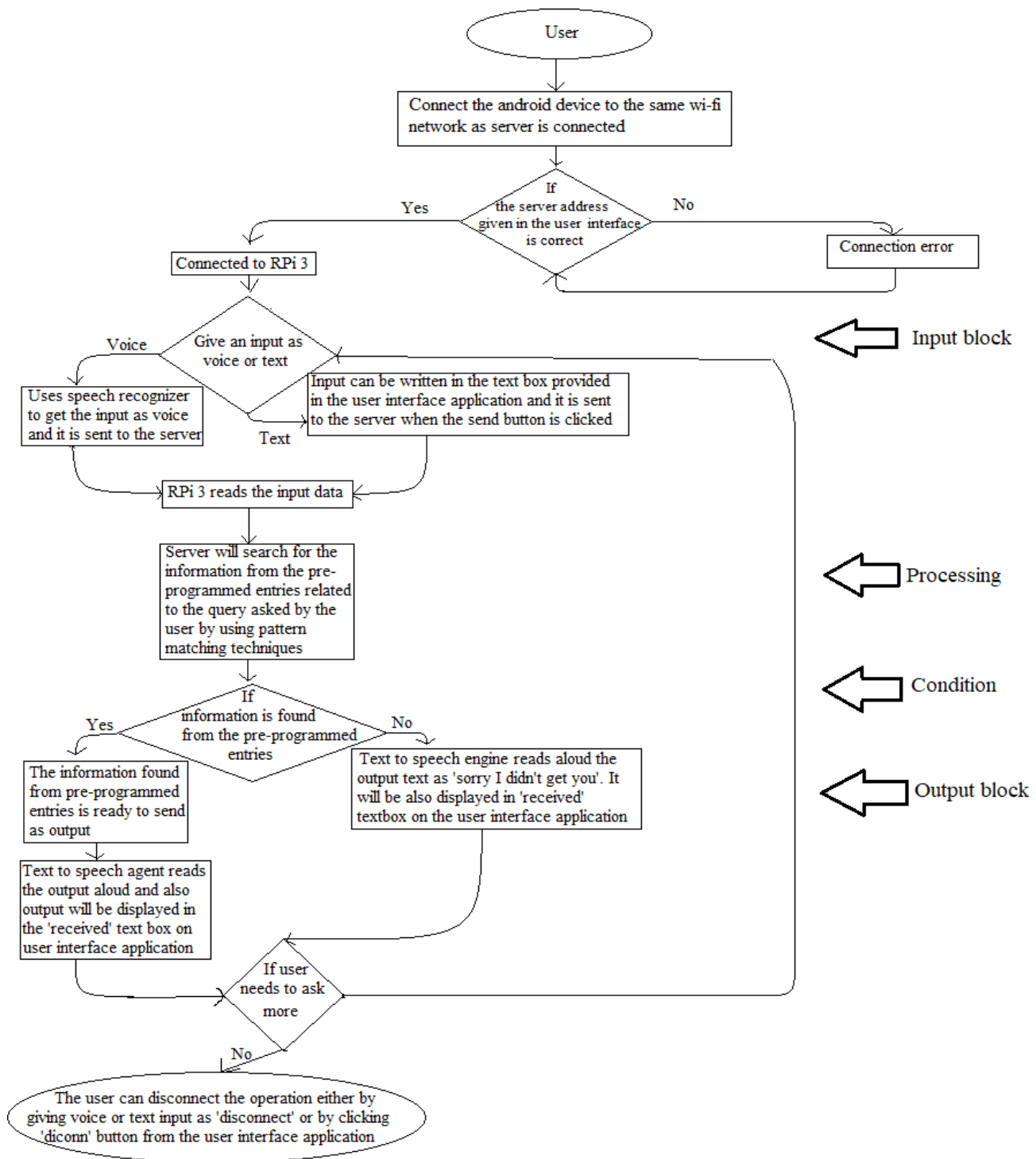


Figure 2: System Flow Chart.

RPi 3 as Python TCP server and the android based user interface application as client, are the key elements for the functioning of the chatbot system. The flow of the process of the chatbot system has been illustrated step by step and described in fig. 2. The process starts by initializing the android based user interface application and connecting it to the same wi-fi network that is connected by RPi 3 (server). The user interface application requires a socket connection to the server address for the working of the chatbot system.

Thus, providing a wrong server address in the user interface application leads to an error socket connection. The user interface application takes the input data as voice or text format from the user and will be sent to the server. This is represented as the input block in fig. 2. Voice input can be given to the chatbot system using the speech recognizer button

from the user interface application and also text input can be given in the normal form of texts. RPi 3 will read the input data and processes it. The collecting of information related to the queries asked by the user from the pre-programmed entries using pattern matching techniques are indicated as processing block in fig. 2. Pre-programmed entries are the local database that contains a set of pre-programmed queries and answers. The condition in which the server decides whether the information related to the queries asked by the user is present in a local database or not is indicated as a condition block in fig. 2.

The output will be obtained from the user interface application invoice format using text to speech engine and in text format as well. This is indicated as the output block in fig. 2. The input block involves a decision box because of selecting either voice format or text format for sending the inputs and the condition block also involves a decision box as the server is deciding whether the information is present in the database or not. The processing block and output block involves a rectangle box, and all the boxes are followed with flow directions.

DISCUSSION OF RESULTS

The user should give the proper server address of the Raspberry Pi 3 in the user interface application to establish a socket connection. The raspberry pi is the main device used for the working of the developed project system which takes the input data from the user through Wi-Fi and provides the result to the user through Wi-Fi itself as illustrated in fig.3.

The user interface application acts as the client and the raspberry pi acts as the Python TCP server. The Raspberry Pi 3 is the key device used for developing the project system and it comes with an on-board 802.11n Wireless Local Area Network (WLAN) adapter, so an extra purchasing of Wi-Fi dongle is not required. Wi-fi dongle is a pocket-sized device that helps the user to access the internet on the go. Both the client and server must be connected to the same wi-fi router and the client requires to connect to the server's IP address. Raspberry Pi can be powered with a micro USB cable by connecting to a 5V AC adapter. High Definition Multimedia Interface (HDMI) cable is used to transmit the video/audio signal to a monitor so as the developer can get the program operating window.

A keyboard and a mouse are connected to the USB terminals. Just top to the micro USB power connector on the raspberry pi circuit board, an SD card slot is available where an SD card with the loaded Raspbian OS can be inserted. Once the SD card is inserted, the Raspberry Pi will boot Raspbian OS from the SD card. The Python 2.7 programming software is used to program the chatbot system. The fig. 3 represents the diagram of system testing.

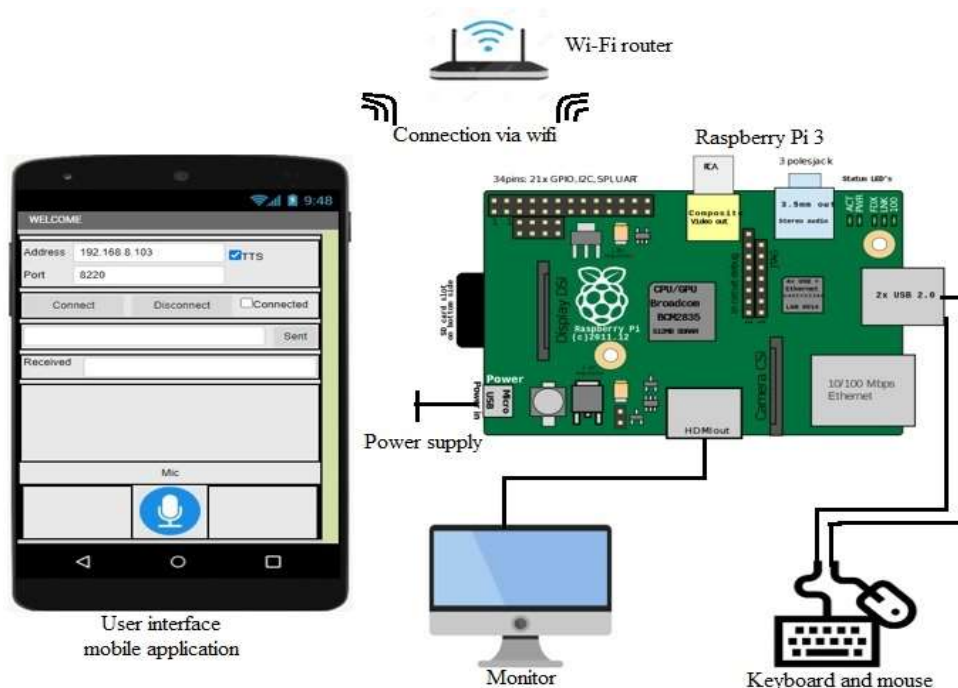


Figure 3. System Testing

Fig 4 represents the app inventor designer window, and it has four types of sections. The palette section contains many tools like sensors (accelerometer, barcode scanner, magnetic field sensor, etc.), connectivity tools (web, Bluetooth server, and client, etc.), etc. The user interface tab from the palette is used to design the screen view of the user interface. By

clicking on the user interface tab in the palette, it will display the elements like a spinner, slider, label, button, etc. So, just dragging them to the viewer section is enough to design the screen view of the user interface.



Figure 4: App inventor designer and blocks editor window

The Components section shows the components used from the palette section for designing the application. The Properties section is used for editing the names, background color, text tool which contains font style, text size, alignment, etc. The speech recognizer and text to speech tools will be in the media tab present in the palette section. These tools are used for the chatbot system to send the input as voice also receiving the output as voice. The text to input (TTS) is also called read-aloud technology which reads the digital text aloud. So, whatever the text obtained at the output will be read aloud using this tool in the developed chatbot system. In android mobile phones by default, speech recognizer and text to speech uses Google TTS engine. Also, in this developed chatbot system, the Google TTS engine is used for sending and receiving voice inputs.

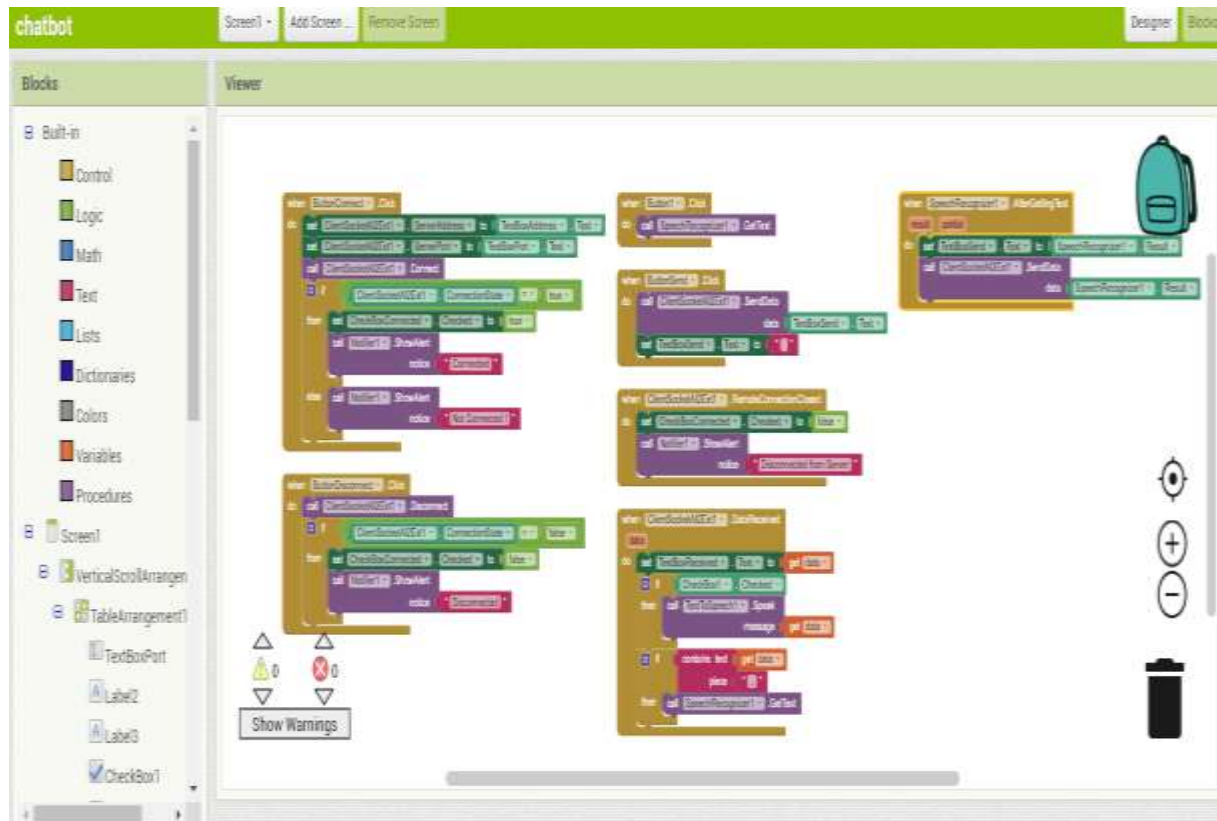


Fig. 5: App inventor designer and blocks editor window

The client socket extension is a key component used for server-client communication. So, a socket extension is used for the connection between the user interface which acts as the client and the Raspberry Pi 3 which acts as a server. The

server establishes an address (binds) first, which the client can use to find the server. The server waits for the client to request a service. Therefore, the socket is the component responsible for the connection between client-server hence the client-server data exchange takes place. It is required to provide the server's IP address on the server address tab in the client socket extension tool menu before building the android user interface application. Then only, the client can connect to the server through the socket.

The fig 4 and 5 represents the blocks editor window. Using blocks editor window, the working of the system can be programmed or assembled using some fitting pieces structures like puzzles instead of programming codes. The results of various test performed are provided in table 1.

Table 1: Tests and Results

Test cases	Queries asked by the user	Desired response from the chatbot database	The response given by the chatbot system
T1	Which semester is this now?	'This is spring 2020' or 'spring 2020'	This is spring 2020
T2	What is my attendance for vlsi module	'Your attendance is 75 percent' or '75percent'	Your attendance is 75 percent
T3	Again vlsi attendance how much?	'Your attendance is 75 percent' or '75percent'	75percent
T4	Hi can I have an appointment for Asif sir	'appointment booked for coming Tuesday 9am to 10am' or 'booked for coming Monday from 3pm to 4pm' or 'no problem appointment booked for coming Thursday 11 am to 12 pm'	problem appointment booked for coming Thursday 3pm to 4pm' or 'no problem appointment 11 am to 12 pm'
T5	When is the submission deadline for radar assignment?	'the submission deadline for first assignment will be on 12 June 2020 and second will be declared later' or 'the first assignment 2020 and second will be submission deadline will be on 12 June 2020 declared later and second will be declared later'	the first assignment submission deadline will be on 12 June 2020 and second will be declared later
T6	disconnect	'disconnected'	disconnected
T7	hehe	'sorry I didn't get you'	Sorry I didn't get you
T8	Any activities going in IBR building	'A workshop based on how to prepare a good resume is going on in room number 213' or 'you electronics today at 4 clock do not have any activities currently now but a business quiz will be conducted at 3 o clock by business club' or 'a quiz will be conducted by electronics today at 4 clock'	a quiz will be conducted by electronics today at 4 clock
T9	Is there any program going on in ibr building	'A workshop based on how to prepare a good resume is going on in room number 213' or 'you prepare a good resume is going do not have any activities currently now but a business quiz will be conducted at 3 o clock by business club' or 'a quiz will be conducted by electronics today at 4 clock'	A workshop based on how to prepare a good resume is going on in room number 213
T10	Can you please check if Muhammad Bashir sir is available this and please book an appointment for him	'appointment booked for coming Tuesday 9am to 10am' or 'booked for coming Monday from 3pm to 4pm' or 'no problem appointment booked for coming Thursday 11am to 12pm'	booked for coming Monday from 3pm to 4pm

In our designed system, the server and client must be connected with the same Wi-Fi network for enabling a TCP connection. The user interface application only works in Android OS. The RPi 3 board becomes hot quickly while working with it, so a cooling fan is required to be kept along with the RPi 3 board. The user interface application would not connect to the server's address of RPi 3 when a wrong IP address of the server is provided in the user interface application, hence it shows socket error connection. By giving input 'disconnect' as text or voice will disconnect the user interface application with the RPi3. The students can interact with the chatbot system using android based user interface application by asking queries related to student information and learning activities.

Hence, it enhances the student's engagement in all learning activities and improvising the learning process. Further development in the programming of the chatbot system and in the database will make the chatbot system more flexible. Further gathering of metrics, collecting surveys, and continuous monitoring of the success of the chatbot system can improve itself over time. The application of the developed chatbot system in this project is for education. The developed chatbot system can be also used for home automation, conversational commerce, customer service, personal assistance, etc. by using appropriate programming.

CONCLUSIONS

The developed chatbot system was aimed at enhancing the student's engagement in all educational activities. A range of literature review information is obtained from detailed research based on the topic 'AI based chatbot systems in the educational field'. The developed chatbot system follows ALICE program, and uses three different types of pattern matching techniques which are keyword detection technique, symbolic reduction technique, and synonyms resolution technique. The system working is based on Transmission Control Protocol (TCP) server to client connection. Android-based user interface application was developed using an online platform which is MIT app Inventor 2. The TCP server is developed using Python ver-2.7.16 software on Raspbian OS. The server to client connection is established using a socket. In a designed system, both the functional units are required to connect with the same network which enables the TCP/IP data transmission over the same network. The results are obtained from the android based user interface application and using Python Interpreter. Python Interpreter lists out the queries asked by the user and responses by the chatbot system for every chat session.

The results obtained from the user interface application and python interpreter are verified with the three different types of techniques used for developing this chatbot system. The keyword detection technique is used to detect the main keywords present in the sentence asked by the user and providing a suitable response from the template which is already pre-programmed in the programming file. The symbolic reduction technique is used to reduce the complexity of the sentence by splitting it into individual words. Thus, keywords can be detected and provide the output from the related keyword's template. The synonyms resolution technique is used to find the keywords with the same meaning. Hence selecting it as a keyword and finding the information from the related keyword's template. The results are verified with these techniques using the developed chatbot system by asking different queries.

The project can be further improved by extending the programming script of the chatbot's server and the pre-programmed entries. The developed project system can be implemented in educational institutions to enhance the student's engagement in all learning activities. The institution which is implementing this chatbot system can use their local database rather than pre-programmed entries, thus the chatbot system can become more efficient in providing the output. Designing user's authentication will improve the privacy and security of the users. Further development in Natural Language Processing (NLP) will make the chatbot system more efficient, user friendly, and more flexible by feeding them with new information over time.

Acknowledgment

The conducted research is supported by Middle East College, Muscat, Oman. The authors are extremely grateful and would like to thank the department of Electronics and Communication Engineering as well as those who supported this research directly or indirectly.

REFERENCES

- Diwanji, P. H. (2018). [online] available from <https://pdfs.sema>. 'Enhance Classroom Preparation for Flipped Classroom using AI and Analytics'. *Proceedings of the 20th International Conference on Enterprise Information Systems*.
- Fawaz, A., Ali, M. B., Adan, M., Mujtaba, M., & Wali, A. (2021). A Deep Learning Framework for Efficient High-Fidelity Speech Synthesis: StyleTTS. *iKSP Journal of Computer Science and Engineering*, 1(1).
- Hajare, A. B. (2018). Chatbot for Education System. *International Journal of Emerging Technology and Computer Science*, 3(2), 43-48.
- Lerma, J. M. C. (2021). SmartHipona: Distributed Computer System to Record the Academic Performance in Real Time. *iKSP Journal of Computer Science and Engineering*, 1(1).
- Naveen, K. L. (2016). Android Based Educational Chatbot for Visually Impaired People. *International Conference on Computational Intelligence and Computing Research*.
- Oh, K. L. (2017). A Chatbot for Psychiatric Counseling in Mental Healthcare Service Based on Emotional Dialogue Analysis and Sentence Generation. Oh, K., Lee, D., Ko, B., and Choi, H. (2017) 'A Chatbot for Psychiatric

Counseling in Mental Healthcare Service Based on Emoti IEEE International Conference on Mobile Data Management (MDM) 1, 371-37.

Ram, M. (2019). Chatbot based College Information System. *International Journal of Multidisciplinary* , 4(3), 109-112.

Sarthak V., D. S. (2017). Artificial Intelligence Chatbot in Android System using Open Source Program-O. (2017) 'Artificial Intelligence Chatbot in AnInternational Journal of Advanced Research in Computer and Communication Engineering , 6(4), 816-821.

Sonali, M. a. (2010). Advancements in the V-Model. *International Journal of Computer Applications*, 1(12), 29-34.

Tim, H. (2019). *Can a computer fool you into thinking it is human?* (BBC News) Retrieved 1 14, 2020, from <https://www.bbc.com/news/business-49344596>