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Hyperspectral multi-level image thresholding using qutrit genetic algorithm

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ARTICLE INFO

ABSTRACT

Hyperspectral images contain rich spectral information about the captured area. Exploiting the vast and redundant information, makes segmentation a difficult task. In this paper, a Qutrit Genetic Algorithm is proposed which exploits qutrit based chromosomes for optimization. Ternary quantum logic based selection and crossover operators are introduced in this paper. A new qutrit based mutation operator is also introduced to bring diversity in the off-springs. In the preprocessing stage two methods, called Interactive Information method and Band Selection Convolutional Neural Network are used for band selection. The modified Otsu Criterion and Masi entropy are employed as the fitness functions to obtain optimum thresholds. A quantum based disaster operation is applied to prevent the quantum population from getting stuck in local optima. The proposed algorithm is applied on the Salinas Dataset, the Pavia Centre Dataset and the Indian Pines dataset for experimental purpose. It is compared with classical Genetic Algorithm, Particle Swarm Optimization, Ant Colony Optimization, Gray Wolf Optimizer, Harris Hawk Optimization, Qubit Genetic Algorithm and Qubit Particle Swarm Optimization to establish its effectiveness. The peak signal-to-noise ratio and Sørensen-Dice Similarity Index are applied to the thresholded images to determine the segmentation accuracy. The segmented images obtained from the proposed method are also compared with those obtained by two supervised methods, viz., U-Net and Hybrid Spectral Convolutional Neural Network. In addition to this, a statistical superiority test, called the one-way ANOVA test, is also conducted to judge the efficacy of the proposed algorithm. Finally, the proposed algorithm is also tested on various real life images to establish its diversity and efficiency.

1. Introduction

Hyperspectral Image (HSI) contains a large amount of spectral and spatial information (Du & Yang, 2008). The number of spectral channels varies from 10 to 400. This abundance of information in HSI has motivated to expand its applications in various fields like precision agriculture (Elmaizi, Nhaila, Sarhrouni, Hammouch, & Nacir, 2019), geological mapping, remote sensing (Ozkan & Akar, 2019), medical diagnosis (Weijtmans, Shan, Tan, de Koning, & Ruers, 2019), environment monitoring (Li, Zhang, & Huchuan, 2018) to mention a few. Despite being advantageous, huge amount of redundant information is generally present in HSI. Different dimensionality reduction methods are used to reduce the computational burden (Das, Bhattacharya, Routray, & Deb, 2019).

Image segmentation is a fundamental step in image processing and analysis. Segmentation basically divides an image into meaningful parts based on some common features like color, intensity or texture (Oliva et al., 2019). Image segmentation methods can be classified into four categories (Naidu, Kumar, & Chiranjeevi, 2018). These are region based methods (Sun & Wang, 2019), boundary based methods (Thanh, Hien, Prasath, Thanh, & Hai, 2020), clustering based methods (Zhu, Pei, Liu, & Zhou, 2019) and thresholding based methods (Naidu et al., 2018). Thresholding based methods have gained popularity,since these are easy to implement and provide accurate results. The threshold values can be

ROLE AND IMPACT OF THE THREE TIER OF GRAM PANCHAYAT : A GENERAL CASE STUDY OF CHAMPAGURI GP OF NAGRAKATA BLOCK

☐ Jaya Kepchaki*

ABSTRACT

In the democratic country like India the concept of power decentralization has taken because it is believed that through this process of power decentralization the participation of people in government policies in urban as well as in rural development will actively increased. The Dooars region of West Bengal is the main concern of my paper to understand the relationship between panchayat and the democratic concept. In this paper my main topic is only concentrate upon rural development through Panchayat. To develop the grass root level people it is very important to participate all the people in actively through the three tiers of Panchayat systems like Gram Sabha, Gram Sansad and Gram Unnayan Samityt. Panchayat as a participatory institution at the grass root level has been institutionalized through a series of legal, political and administrative measures. To understand deeply in this matter I choose the Nagrakata Block Panchayat offices of Dooars region of Japlaiguri district of West Bengal in this regard.

Keywords : Democracy- Decentralization- Development

INTRODUCTION :-

In a democratic state the importance of local self government is undeniable. To conduct smoothly the administrative work in a democratic state it is necessary to increase awareness and efficiency into the citizens itself. And it is possible only by the self government institutions. Therefore, in a democracy self government institutions are the only one main institution. Citizens feel more responsible and self reliant to work in a self government institutions.

In the recommendation of Balwant Ray Mehta Committee in the late 50s the Panchayat Raj system was established but could not make its deep roots in the country. After that the Ashok Mehta committee with the cooperation of Janata Government formed the basis of the new Panchayat system with some changes. In this regard Karnataka, Kerala and West Bengal led the new panchayat system with full enthusiasm but only West Bengal success to run the program. Since 1980s after the emerged of Left Front Government in West Bengal the

Panchayat has been attributed for playing significant role in the remarkable economic spin of the state. It was seen that since 1978 only West Bengal has been organized the party basis elections regularly in every five years. Local Self Government get its constitutional status in 1992 by the 73rd and 74th Constitutional Amendment act. In the 73rd constitutional amendment act, the west Bengal government has formed three tiers for people's participation- Gram Sabha, Gram Sansad and Gram Unnayan Samity.

These three tiers of administration take people in the grass root level development. As my paper concern the Nagrakata Block is under the district of Jalpaiguri, West Bengal. This area is surrounded by the tea garden and forest busty areas and near about 70% of the population belongs to the Adivasi Tribals. Under the Nagrakata Block there are Sulkapara GP, Looksan GP, Champaguri GP, Angrabhasa1 GP and Angrabhasa2 GP.

Gram Sabha :-

A Gram Sabha has been defined as ' a body

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Education becomes 'Online' in the Covid Era: The World Scenario

Dhiman Chakraborty
&
Monotosh Pramanik

Abstract:

There is a time when a teacher can recognize a student's mind with his facial expressions and tried hard to reach out to the difficult areas! Now everything is under lockdown for more than 15 months and we are struggling to cope with the new normal— work from home. Everybody is used to the circumstances and schools and colleges are now like archaic museums. The sea-change of educational circumstances is the basic need to adjust both by teacher and students. There are huge obstacles and challenges that we have to overcome— survival in a pandemic, economic and physical well-being , and mental trauma. The scarcity of online infrastructure and the internet make a huge task to overcome. Governmental schemes to provide tablets and computers sometimes helps but only a drop of water in the ocean! Whereas developed countries administered more vaccines to cover herdimmunity we are still lagging to produce enough vaccines to coverup our countrymen against the timely decision!

Keywords:

Online, Education, Covid era, pandemic, lockdown, internet, psychological health.

I

As an unprecedented crisis befalls the nation withCovid 19 wreaking havoc in all spheres of human existence, life seems to have come to a standstill. Naturally, with the primary instinct of survival being the priority, educational institutions have been closed since 24th March 2020 , but apparently, in a bid to not let education take a 'backseat', the government insists on shifting the entire procedure of teaching to assessment on virtual platforms, underscoring the fact that digitization is the key for survival in today's world. However, the question that plagues our mind is that when in such a situation the focus should be actually on human life, why is the government busy with such schemes which do not help us any better in fighting this pandemic situation?

During a time of the pandemic, infused with failing economies,when man's survival and sustenance is at stake, there are no doubt that education is a privilege. Yet education is one of the limbs without which civilization cannot exist. When physical proximity is deathly dangerous, the twenty-first century, intoxicated by the virtual and practically living in it, quite obviously makes a move on that trajectory and pretends to call it 'online education'.

According to UNICEF, in 71 countries worldwide, less than half the population has access to the internet. Despite this disparity, 73 percent of governments out of 127 reporting countries are using online platforms to deliver education while schools remain closed. Even developing countries across Latin America and the Caribbean region emphasize learning through online platforms.As nearly 1.2 billion schoolchildren remain affected by school closures and as they grapple with the realities of

Quantum fractional order Darwinian particle swarm optimization for hyperspectral multi-level image thresholding

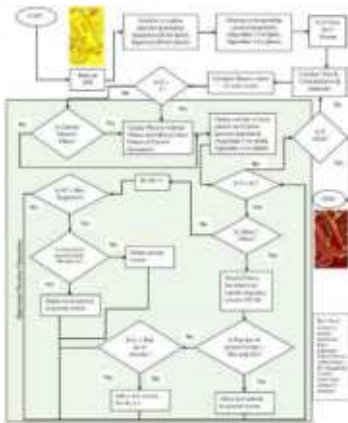Tulika Dutta [a], Sandip Dey [b], Siddhartha Bhattacharyya [c,*], Somnath Mukhopadhyay [d]

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GRAPHICAL ABSTRACT

ARTICLE INFO

ABSTRACT

A Hyperspectral Image (HSI) is a data cube consisting of hundreds of spatial images. Each captured spatial band is an image at a particular wavelength. Thresholding of these images is itself a tedious task. Two procedures, viz., Qubit Fractional Order Particle Swarm Optimization and Qutrit Fractional Order Particle Swarm Optimization are proposed in this paper for HSI thresholding. The Improved Subspace Decomposition Algorithm, Principal Component Analysis, and a Band Selection Convolutional Neural Network are used in the preprocessing stage for band reduction or informative band selection. For optimal segmentation of the HSI, modified Otsu's criterion, Masi entropy and Tsallis entropy are used. A new method for quantum disaster operation is implemented to prevent the algorithm from getting stuck into local optima. The implementations are carried out on three well known datasets viz., the Indian Pines, the Pavia University and the Xuzhou HYSPEX. The proposed methods are compared with state-of-the-art methods viz., Particle Swarm Optimization (PSO), Ant Colony Optimization, Darwinian Particle Swarm Optimization, Fractional Order Particle Swarm Optimization, Exponential Decay Weight PSO and Heterogeneous Comprehensive Learning PSO concerning the optimal thresholds, best fitness value, computational time, mean and standard deviation of fitness values. Furthermore, the performance of each method is validated with Peak signal-to-noise ratio and Sørensen–Dice Similarity Index. The Kruskal–Wallis test, a statistical significance test, is conducted to establish the superiority

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Quantum inspired meta-heuristic approaches for automatic clustering of colour images

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Abstract

In this article, quantum inspired incarnations of two swarm based meta-heuristic algorithms, namely, Crow Search Optimization Algorithm and Intelligent Crow Search Optimization Algorithm have been proposed for automatic clustering of colour images. The performance and effectiveness of the proposed algorithms have been judged by experimenting on 15 Berkeley images and five publicly available real life images of different sizes. The validity of the proposed algorithms has been justified with the help of four different cluster validity indices, namely, Pakhira Bandyopadhyay Maulik, I-index, Silhouette and CS-measure. Moreover, Sobol's sensitivity analysis has been performed to tune the parameters of the proposed algorithms. The experimental results prove the superiority of proposed algorithms with respect to optimal fitness, computational time, convergence rate, accuracy, robustness, t-test and Friedman test. Finally, the efficacy of the proposed algorithms has been proved with the help of quantitative evaluation of segmentation evaluation metrics.

KEYWORDS
automatic clustering, clustering validity measures, Friedman test, intelligent crow search optimization, quantum computing, segmentation evaluation metrics, Sobol's sensitivity analysis, t-t

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Germophobia's Impact on Consumer Buying Behaviour during Covid-19 Pandemic

Dhiman Chakraborty and Parveen Kumar

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Abstract
For the last few months, human beings throughout the globe suffering from germ phobia which is the direct consequence of Wuhan originated Novel Coronavirus. COVID-19 which is the scientific name of this virus-related disease makes some psychological terror in the minds of general human beings who are never expected to have such struggles like that of the lockdown or social distancing! Constantly washing hands with soaps or hand washes or use sanitizers or using masks or wearing PPE for healthcare professionals-all are the hygienic manners that we are using first time in our experiences! And this is due to the germ phobia which we experience in the realm of the pandemic. We are now so scared with this germ phobia that we even avoid our near and dear ones to visit or handshakes. This is a peculiar situation on this earth and civilization and even WHO said that we have to practice our lives with this virus for long! So the common question is that how we overcome germ phobia and satisfy ourselves with normal world order and behavioral codes. Fear of germ phobia affects many ways to human beings but here we are discussing the impact of germ phobia on consumer buying behavior during the lockdown. What is the spending pattern, what type of goods consumer want to purchase, mode of purchase, frequency of purchase etc. are the questions try to discuss in this paper? Here we choose 120 samples through the convenience sampling technique and used a questionnaire survey research design through Google form by asking dichotomous questions from respondents. The data was analyzed and interpreted through SPSS software. It is concluded that buying behavior was influence by germ phobia during the lockdown. In the end, we try to give some suggestions to overcome the problems.

Keywords: Covid-19, germphobia, lockdown, social distancing, pandemic, WHO

Introduction
The term germ phobia was coined by William A. Hammond in 1879 when describing a case of obsessive-compulsive disorder (OCD) exhibited in repeatedly washing one's hand [12]. Mysophobia, known as germophobia, germophobia, germaphobia, bacillophobia and bacteriophobia, is a pathological fear of contamination and germs [6]. (*Germaphobe | Definition of Germaphobe at Dictionary.Com*, n.d.) Dictionary means germophobe, a person who has an irrational or disproportionate fear of germs and contamination [5]. Very simple words germ phobia is a fear of germs, bacteria, microbes, contamination and infection in the psychology of human being. "We are 'Us' only in the eyes of others, and it is in terms of the other's look that we assume ourselves as 'Us'". (p.517) Being and Nothingness, Satre. So according to Satre, there is a clear distinction between the oppressor and the oppressed, in terms of mentality and class distinction. There is a clear urge to overcome the oppression of the 'we subjects': 'The assumption of the "Us" in certain strongly structured cases as, for example, class consciousness, no longer implies the project of freeing oneself from the "Us" by an individual recovery of selfless but rather the project of freeing the "Us" from the object-state by transforming it into We-subject.'(*Being and Nothingness, pp. 515-516) T*he collective unconscious of society is the appearance of our individual mentality and we, the human beings are certainly self-serving and possessive. But the current circumstances of social distancing

and the phobia of existence is the current situation. Mysophobia or Germaphobia was first introduced in 1879 by William A Hammond. There are certainly some unique characteristics which is the root cause of this mental situation:

- Excessive washing of one's hands and dire urge of cleanliness.
- Do not participate in dirty tasks.
- Avoiding personal washrooms and share personal items like soaps to toothpaste.
- Reluctance into gathering social programs.

In the realm of COVID-19 in the first quarter of 2020, we learn how to avoid globalized contact, taking the entire globe into a complete whole. To the complete opposite of common day perceptions of mutual understanding into social levels, this contagious disease certainly leaves apart from the community gatherings and taking serious concerns about hygienic and distancing manuals. The anxiety of coronavirus is suddenly topped in the levels of uncertainty regarding the corona virus. Sometimes the anxiety of the virus troubled too much to the cause of mental disposition.

After panic-buying of essential for months, human beings finally recognized that the whole world was dominated by the psychology of fear due to Germ phobia. Westerners are bearing anti-Asian sentiments due to the origin of the virus in Wuhan in China. The untouchability previously dominated due to racial hatred in India now has some scientific backdrops also-social distancing in the mode of avoidance of virus spreading. The older generation may be expressed their anger with boringness and depression. The medical uncertainty of the virus and its unknown history it make the situation too much terrifying. The unfamiliarity of the disease and the unknown circumstances of the pathogen and its spreading make the virus the true name of fear. Another very important reason is the leadership failure all over the world where true and timely decisions are needed tremendously but failed due to the unknown features of the virus. This mental anxiety is so much terrifying that human beings are making lockdowns hoping to eliminate virus contacts but failed. They heavily believed that they may overcome the virus only by separating themselves from social touches or gatherings! There are some over-optimists also who are spreading hard-immunity theory to make auto-immune systems in their bodies. Countries like Sweden are the direct follower in this respect. So the fear of the virus is of two folds-avoiding social connections and making hard-immunity. Stress can also impact our immunity as some experts said. Mental health experts said that taking less stress over this germaphobia is the cause of mental strength. This lockdown due to the coronavirus has two main reactions-fear and worry over an uncertain future and careless attitude and ignorance about the prevailing threat of the spread of the virus. Some experts even urge that circulating jokes or humour in social media also serves some anxiety relief in the time of germaphobia. Stress in the time of COVID-19 may produce these outcomes-

- Worry, fear and anxiety about your own health and the health of your loved ones.
- Differences in sleep and eating patterns.
- Low levels of concentration and difficulty in sleeping.
- Worsening in mental health conditions.
- Due to phobia increased use of alcohol, tobacco, or other drugs.

Some concerns are definitely important to consider the impact of germophobia on the economy, society, politics and others. Before the pandemic, the situation is something different from what is now available. The drastic changes are seen in business, commerce, market economy and buying behaviour of customer psychology. The fear of less income or spending too much money is another phobia that one can notice after the sudden change of market economy due to lockdown which we faced constantly for the last few months. The psychology of the customer is worth notice in this respect. The economy is a cycle that must be moved on regressively-it cannot be stagnant and stoic. But this germ phobia COVID-19 certainly closed the motion of economy with the lockdowns which we are noticed. The buying psychology of the customers is downgraded noticeably not only by the causes of germophobia but also the stagnation of the economy symbolically by the loss of jobs and shut down of the markets. The oral opinion of market experts revealed that there is only 1/3 of the business going. They are in fear that the supply chain of the economy can be cut down by the lockdowns as wells as the psychological fear of the customers. Even the customers are not spending when they have money in their hands. The reason is quite natural as the uncertainty of the atmosphere in the market and income rouses questions in their minds. The courage of buying something depends on the positivity of the mindset. This pandemic gives us so much gloomy atmosphere that the hope for investment and capital engagement in the market economy is rare. Even the companies reduced their production and wait for the normalised situation after the vaccinations. The pay cards and loss of a job are new normal in this market economy. Thus overcoming this germaphobia in the dimension of normalise economy is very important to study in this paper.
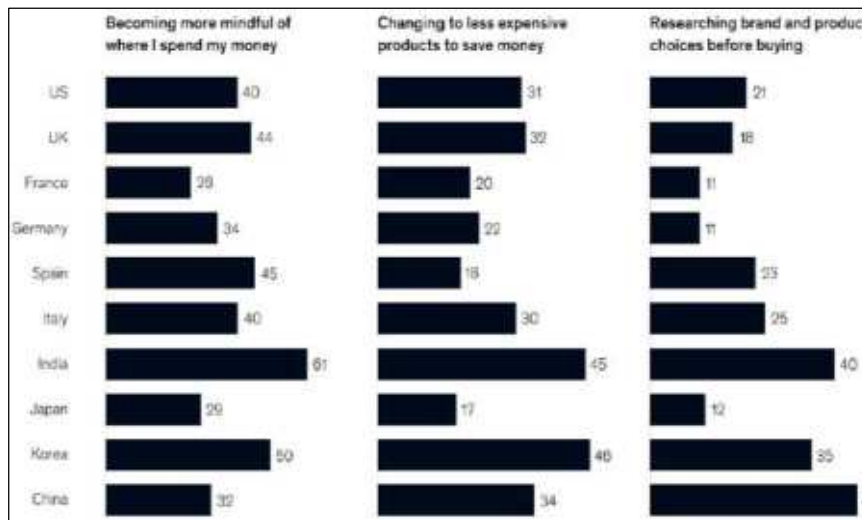
Consumer buying behavior during lockdown
(Shawn, 2015) Consumer buying behaviour is the sum total of a consumer's attitudes, preferences, intentions and decisions regarding the consumer's behaviour in the marketplace when purchasing a product or service. In other words, buying behaviour is the act or decision of people to buy or use a product [13]. (Study Reveals Drastic Change in Consumer Behaviour during Lockdown-The Hindu Business Line, n.d.) "For the analysis, data and insights from the month of March represent the spending patterns of individuals in anticipation and immediately after the announcement of the lockdown, while April represents consumer spending behaviour during the lockdown. Though credit card spending dropped initially by 10 percent when the lockdown was announced in March, it slid even further by 51 per cent when the lockdown was in full swing April-onwards. In March, cab spends decreased by 43 per cent in Delhi, 39 per cent in Mumbai and 41 per cent in Bangalore. Travel spends also decreased by 50-55 per cent across Delhi, Mumbai and Bangalore, the study showed. In April, with the lockdown firmly in place, fuel spends decreased in Delhi by 53 per cent, Mumbai by 78 per cent and Bangalore by 55 per cent. Cab spends also decreased in Delhi by 88 per cent, Mumbai by 90 per cent and Bangalore by 89 per cent. Also on the slide were travel spends in Delhi by 87 per cent, Mumbai by 86 per cent and Bangalore by 85 per cent" 3. Try to track which city start panic buying in emergencies situation study reveals that Delhi stocking up more than Mumbai and Bangalore. Delhi ties start panic buying during the lockdown and start stocking

essentials items. Card spending on groceries, fuel and other utilities of Delhi ties was more than other two metro cities. Bangalore Residents however, did not rush to stock up as much, maintaining only marginal increases in most essential categories in March. Thus, the study states, indicates the trust in access to essentials was the highest in Bangalore, making residents least likely to resort to panic buying and hoarding [15].

It is clear from the above paragraph that buying behaviour of consumer change drastically. Consumers are more conscious and aware their spending pattern and preference regarding goods and services had been changed, downfall in expenditure on luxury and prestigious goods and a sharp increase in essential goods and services. With many people expecting COVID-19 to negatively affect their finances as well as their daily routines for at least another four months, consumers are being mindful about their spending and trading down to less expensive products. There has been a shift to mindful shopping including some trading down for value (N. Arora *et al.*, 2020) [2].

Change in shopping mind set since COVID-19 [1].
% of respondent who are doing more [2].

	Becoming more mindful of where I spend my money	Changing to less expensive products to save money	Researching brand and product choices before buying
US	40	31	21
UK	44	32	18
France	29	20	11
Germany	34	22	11
Spain	45	18	23
Italy	40	30	25
India	61	45	40
Japan	29	17	12
Korea	50	48	35
China	32	34	4

1Q: *"Which best describe how often you are doing each of the following items"?* possible answers: "doing less since coronavirus started"; "doing about the same since coronavirus started"; "doing more since coronavirus started" 2Percent of respondents answered that they are doing more since COVID-19 started.
Source: Mckinsey and company COVID-19 consumer pulse survey, conducted globally between June 15 and 21 June, 2020 [10].

Mckinsey & Co. consumer pulse survey data shows that 61% of Indians are more mindful about where to spend their money. In the time of pandemic situation, Indian consumers are more conscious. 45% of Consumer of India giving much priority to less expensive goods to save money for the future. 60% of Indians still thinking about brand and product before buying. COVID-19 creates suspense in the mind of the consumer, they are not sure about the future.

Literature review
According to a World Gold Council, WGC 2020 (India's Gold Demand in April-June Sinks 70 per Cent on COVID-19 Disruptions: WGC-The New Indian Express, n.d.) Report, Gold demand in India plunged 70 per cent during the April-June quarter to 63.7 tonnes compared with the same period last year mainly due to the nationwide lockdown to prevent the spread of COVID-19 and high prices [9].

According to The Indian Express (Explained: How the Covid-19 Pandemic Has Changed Consumer Behaviour | Explained News, The Indian Express, n.d.) Across the world, as people become confined to their immediate neighbourhoods, the trend of "buying local" is accelerating.

People have become more mindful of what they are buying. "They are striving to limit food waste, are more conscious of costs and interested in buying more sustainable options", said the Accenture report. Neha Rawla, head, brand communications at Forest Essentials told The Indian Express, "Covid-19 has brought two major shifts in customer behaviour: the reluctance to shop in a crowded store and increased propensity towards digital" [4].

In the report of Indian express news (How Pandemic Is Reshaping Consumer Behaviour Post-Covid-19?, n.d.) Reveal that Indian consumer are changed their spending pattern. They spend more on basic and essential needs. Corona virus crisis has changed the behaviour of consumer now they are more worried about the health of their family. Pay cut and Job uncertainty totally changed the buying behaviour of consumer [8].

Hindustan Times newspaper (The Impact of Covid-19 on the Indian Book Consumer-Books Guest Writers-Hindustan Times, n.d.) published Nelson Book India consumer research study the online survey of 1,084 Indian adults (with a ratio of 60:40 female/male) to examine the impact of reading and buying behaviour on leisure books (excluding academic books) in India was conducted from 14 May to 7 June 2020. The study found that Two-thirds of book readers say they are reading more books since lockdown started. Earlier, Indian book readers read books or listened to audiobooks for an average of nine hours per week. Since lockdown, this has increased by seven more hours a week. Two out of five respondents spend more time reading print books; one in two spends more time reading e-books and one in five in listening to audiobooks [16].

(Ajzen, Icek, 1985) Ajzen explains in the Theory of Planned Behaviour (TPB) that consumer behaviour changes due to some futuristic fear or some unexpected events and switch to arbitrary buying. Two of the three important pillars used in TPB, subjective norm and perceived behavioural control, describe changes in consumer behaviour due to a crisis that impacts the purchase intention or behavior [1].

(Sheth, 2020) the paper concluded that consumer adapt new pattern in the lockdown period their consumption pattern and buying behaviour has totally changed. The lockdown and social distancing to combat the covid-19 virus has generated significant disruptions on consumer behaviour. Due to time-bound and location bound situation, all the consumption pattern has changed dramatically. Now consumers are more technology-friendly. It replaces the existing pattern of consumer buying behavior [14].

(T. Arora & Grey, 2020) Arora and Grey research show that the majority of psychological research on the COVID-19 pandemic has been on mental health outcomes. It is fundamental to produce a better understanding of the likely behavioural alterations in the general population and their impact upon physiological and mental health, which are likely to be mostly negative. Public health policies, measures and media are needed to promote greater self-awareness, self-help and self-care within the home setting to prevent later strains on the healthcare system. Systematic research on health-related behaviours, similar to that of mental health, is needed to better understand the short-and long-term outcomes of the current crisis affecting so many individuals [3].

(Nanda *et al.*, 2019) paper concluded that apart from 'income', 'friends', 'variety of models/range', 'ease of returns', 'delivery services', 'shelf display factors' and 'in-store advertisements' were also found to be significant influential in changing the perspectives of consumers' in purchasing computer peripherals from brick & mortar stores. In a scenario where product price, brand and specifications match, or are nearly the same, the Indian consumers prefer to choose the product according to their income and affordability perspectives [11].

(How COVID-19 Changed the Behaviour of Consumers and Retailers in India, n.d.) Consumer behaviour in India and across the world also changed rapidly over the course of the crisis. While the lockdown resulted in panic buying and people hoarding essential items such as rice, wheat, packaged food, home care products, etc., reports suggest that people did not stock up much on confectionery and beverages, but only rushed to stock up on essentials. Your story has gathered data from Bizom, a SaaS start-up for retailers, for the first 15 weeks of the year. The start-up has been working with more than 350 top brands, including Coca-Cola, Cargill, Hershey's, Molson Coors, Shell and United Breweries [7].

Product that sold pre and post lockdown
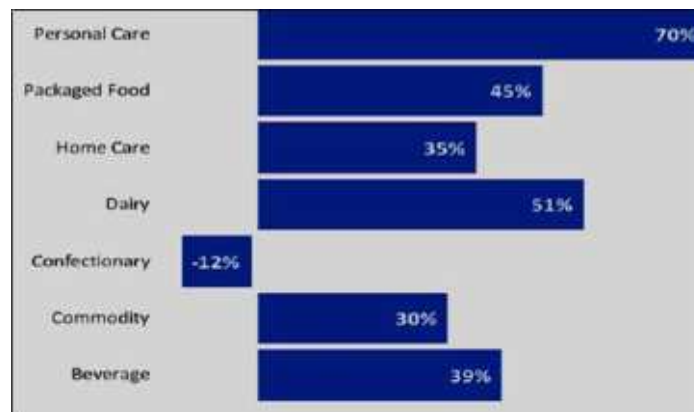
Percentage change in dropsize pre and post lockdown category
Source: Mobisy Analysis

The above data show that how Indian consumers consumed the products during the lockdown period. 70% sales of Personal care items concluded that consumer is more curious about their health during the lockdown. Confectionary sales are negative in lockdown. Most of the family members are present 24 hours in the home therefore, Dairy products and packaged food are also in demand during the lockdown.

Methodology
In order to understand consumer buying behaviour under COVID-19 pandemic the here, we used a questionnaire survey research design through Google form. This study is based on the behaviour of consumers in a pandemic situation.

Sample design
A quantitative method was adopted in the study. The non-probability convenience sampling technique was used because of covid-19 diseases and lockdown rules apply in the study region. 120 samples are selected and Dichotomous questions are asked in the empirical investigation through Google form.

Objective of the study
▪ To understand the impact of the COVID-19 Pandemic on buying behaviour of consumers.
▪ To find out the expenditure pattern of the consumer in lockdown.
▪ To identify the challenges faced by the consumers due to the COVID-19 pandemic.

Hypothesis of the study
H0: There is a significant impact of lockdown on consumer buying behaviour.
H1: There is no significant impact of lockdown on consumer buying behaviour.

Research design

This paper focused on buying behaviour of consumers during the lockdown period. Try to understand the factors which affect the spending pattern of consumer. The whole study is based on the lockdown period due to pandemics. The lockdown period in India starts in phases first lockdown, 25th march 2020 to 15th April 2020 second lockdown, 15th April 2020 to 3rd may 2020 and third lockdown 4th may 2020 to 17 may 2020 and further extend 18th May 2020 to 31st May 2020.

Limitation of the study
- This study is based on only the lockdown period in India due to COVID-19 Pandemic.
- Only telephonic interviews of consumers possible due to diseases.
- Extensive literature relationship on COVID-19 and consumer buying behaviour were not available for in-depth reviews.

Source of data

Primary and secondary data were used in the study, a questionnaire prepared in Google form and send to the consumer to fill up. Government publications, news reports, data of international organizations, research papers and articles, etc. are used as a source of data.

Researchers had used appropriate statistical techniques for data analysis and interpretation. The respondents were classified on the basis of factors influencing buying behaviour.

Table 1: Change in buying Behaviour of consumer during Lockdown period

Response	No. of respondent	Percentage (%)
Yes	85	70.83
No	35	29.16
Total	120	100

Source: Primary.

The figure in the above table shows that there is a huge change in consumer buying behaviour during the lockdown period. 85 respondents out of 120 admitted that their buying behaviour has changed in the period of lockdown.

Table 2: Store Essential goods for future after the declaration of first lockdown

Response	No. of respondent	Percentage
Yes	92	76.66
No	28	23.33
Total	120	100

Source: Primary.

According to discussion and observation of the respondent, 76.66% respondent admitted that they store essential items after the deceleration of first lockdown.

Table 3: Impact of germ phobia on consumer buying Behaviour (fear and unsecured)

Response	No. of respondent	Percentage (%)
Yes	67	55.83
No	53	44.16
Total	120	100

Source: Primary.

The figures in the above table showed the percentage of respondents according to fear and insecurity about the COVID-19 disease. 55.83 percent of respondents had opined that there is a great impact of COVID-19 on their buying behaviour. Therefore, it is concluded that there is a great impact of insecurity and fear about the COVID-19 disease.

Table 4: Shopping of branded goods during lockdown

Response	No. of respondent	Percentage (%)
Yes	58	48.33
No	62	51.66
Total	120	100

Source: Primary.

Table no. 4 data shows that shopping for the branded product was influenced due to COVID-19. 62(51.66%) consumers prefer to purchase normal goods during lockdown because the continuous extension of the lockdown period disturbs their savings. Brand-conscious customers stick to their brand even in lockdown.

Table 5: Shortage of essential goods (Panic Buying) during lockdown

| Response	No. of respondent	Percentage
Yes	63	52.5
No	57	47.5
Total	120	100

Source: Primary

From day one of lockdown government has requested that we have sufficient essential items no need of panic buying. Table 5 data shows that 47.5% of respondent's response according to government message but 52.5% of respondents starts panic buying.

Table 6: Switch to online shopping during lockdown

Response	No. of respondent	Percentage
Yes	72	60
No	48	40
Total	120	100

Source: Primary

In lockdown 1.0 major online marketing company suspended their services during the lockdown period to take care of their staff and customers. In lockdown 2.0 and 3.0 government has given some relaxation to these companies. 60% of customers opined for online shopping and 40% of the respondent has not to switch there mode of shopping.
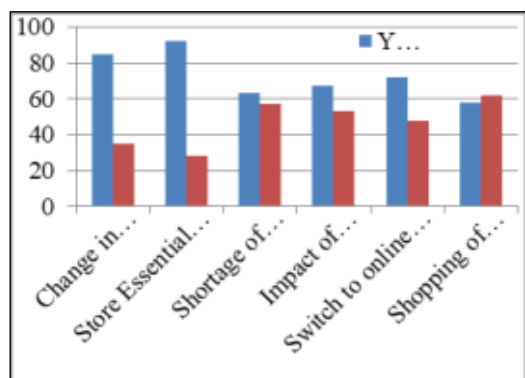
Factors which influence consumer buying behaviour during lockdown

Chi-Square test used for hypothesis testing in this study, calculate value is 30.27 and chi-square distribution value is 11.07. The degree of freedom is 5 and the level of significance is 0.05. It means a 5% risk of rejecting the null hypothesis when it is true. If the calculated 'p' value is greater than the level of significance (0.05) we accept the null hypothesis (P-value > 0.05). While testing the hypothesis researchers found that "p" value arrived at 30.27 which is

greater than the chi-square distribution table value which is 11.07.

Calculated $X^2 = 30.27 >$ table $X^2 = 11.07$

- Null hypothesis is accepted.
- Lockdown due to COVID-19 has changed the consumer buying behaviour.

Conclusion

Government imposes restrictions on the movement of people and strictly implemented lockdown thereafter consumers were taking precautions in the market. The study concluded that strict implementation of lockdown norms changes the shopping pattern of consumers. Nationwide lockdown due to the COVID-19 pandemic has influenced the buying behaviour of consumers. In the study, 70.83% of consumers are agreed that their buying behaviour has changed during the lockdown. 76.66% of consumers are agreed that they store the essential goods for the future during the lockdown. 52.5% start panic buying but not branded items they purchased essential items only. Fear and insecurity are present during lockdown we can say that germ phobia's impact is shown in consumer behavior. Initially, the government restricted the online delivery companies but later government give relaxation. The company received huge order but unable to proceed. Instead of the relaxation online delivery companies not allowed their employee and delivery staffs to deliver because the fear of diseases are very high. 60% of respondents admitted that they switch to online mode during a lockdown.

(Germaphobia, or the Fear of Germs, and Its Treatment, n.d.) Germ phobia-like OCD-is treatable with psychological treatments such as Cognitive Behaviour Therapy (CBT). The basis of CBT is gradual exposure to feared situations and anxiety management strategies such as relaxation and breathing techniques (Wilson, 2020). There are many simple and effective ways to manage your fears and anxieties. Many of them are ingredients for a healthy mental and physical lifestyle [17]:

- Stay informed with the latest health information.
- Limit worry and agitation by lessening the time you spend watching or listening to upsetting media coverage.
- Anxiety is an emotion that tends to seek out confirmation Acknowledge your emotion with understanding and then turn your mind to other things
- Practice mindfulness and acceptance etc.

During the research, it is found that fear or we can say germ phobia is present in the behaviour of humans. A susceptible environment is automatically created among the people. The demand for essential goods is going high in the lockdown. Government communication and awareness program helps a lot to maintain the situation but need more work. A suggestion from a researcher's point of view is that government should work on the root level. Decisions are taken on top-level but implementation on the ground level is the problem in developing countries like India. Need more focus on awareness programmes and schemes for poor and unregistered labour. Mental and physical health is very important in this time government should work on that area.

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