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Availability of Deep and Optimal Analysis of Snacks Food Production Industry using Markov Mathematical Modelling (MMM) with Optimization Algorithm

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ABSTRACT

The vital role of this study deals with the mathematical representation and the availability of snacks food production industry. The Markov mathematical modelling (MMM) with optimization algorithm analyzes the availability of proposed model. This system consists of seven subsystems including Core Building Machine (CBM), Brazing machines (BM), Air Leak Testing Machine (ALT), Tungsten Inert Gas Welding (TIG), Inner Leak Testing (ILT), Helium Leak Testing Machine (HT), Foam Pasting Machine (FPM), which are connected to the series and parallel connections respectively.

***Keywords*:** Snacks Food, Markov Mathematical Modeling, Cauchy Mutation, Particle Swarm Optimization, Failure and Repair Rate.

I. INTRODUCTION

Easy to prepare portions of food taken among main meals is called as snacks. The stage of interest considering the food loss quality determination augmented in the recent years. The major significance from the monetary point examination is the prevention of food losses thereby improving the security of food and hunger compact [1-34]. The huge quantity of food losses happened in households, so, different kinds of supply chain studies are carried out in the last years. Especially, the meat and dairy products requirements are increasing day by day and it leads to the food production requirements from 70% to 90% with 2030 [35-40]. The limited natural resources including mineral fertilizer, land, fossil fuel and fresh water usages are contributed by food production. The vegetables and dairy products showed the huge quantity of stored energy in the garbage. Further, the lower applications of raw materials are directed by the production losses decrement in the food industry thereby improving product quality and minimize the processing of food [33-67].

II. RELATED WORK

The possibility using Near Infrared Spectroscopy (NIRS) model is investigated by Benes et al. [6] that predict salt, sugar, carbohydrate, protein and fat content of each in 155 commercially obtainable snack yields from 25 countries. Different spectral pre-processing methods with partial least squares regression (PLSR) is used as a prediction models. The interval PLS regression and the measured parameters calculates the sample energy content. The freeze dried vegetable snacks in the vegetable bar model was analyzed by Ciurzyńska et al. [56-59]. The three layer snacks with six vegetable gel recipes are involved in this study in which the porous structures are created with the help of hydrocolloid bars. The combination of xanthan gum with locus bean gum and calcium lactate with sodium alginate analyzes the two hydrocolloid systems.

III. METHODOLOGY

The major intention of this work deals with the availability and performance evaluation of snacks food production industry. This system comprises with seven sub systems namely including fryer machines, seasoning machines, infeed conveyor, heat exchanger; inner leak testing, air leak testing machine and cooling conveyor. The probabilistic methodology of Markov mathematical modeling is carried out to evaluate the performance [10]. Furthermore, the optimal framework availability is selected with the help of Particle Swarm Optimization-Based Cauchy Mutation (PSOCM) mechanism The production form makes the production system that modifies huge offerings in the direction of several perfect outputs. This article proposed Markov modeling and simulation for the availability determination in snacks food production industry.

3.1 Markov modeling:

Markov modeling is the major key point of this methodology to deciding the framework of availability. Different kinds of differential conditions are received as of the Transition Diagram (TD) as the largest part of execution to investigate Markov process [11]. The availability of system models in excess of scope of unknown aspects connects the optimization method called PSOCM.

PSOCM for Parameter Optimization

In this work, the optimal parameters are tuned using PSOCM. Each subsystem will gives the optimal values by updating FR and RR to make optimal system reliability in food snacks industry [17,18]. The fitness function evaluates each particles that posses the key function value.

Initialization: To initialize random particle position with its velocities according to the each sub system involved in food snacks industry. Each subsystem with its Repair Rate (RR) and Failure Rate (FR) optimization is the major requirement of this section.

Fitness function evaluation: Based on the objective task of this work such as availability to evaluate the fitness function of PSOCM algorithm. From the given set of values, both FR and RR values are obtained the contribution of optimization.

$$Fitness = Opt\_Rates(FR, RR) \quad (13)$$

For each and every particle, the fitness value is calculated at the initial stage. The best position P_{best} and global best values G_{best} are selected as the optimal one. Select the current optimal fitness value P_{best} following to facilitate iteration. When the P_{best} value is similar to current value then compare the particle fitness value with their P_{best}.

Therefore, the current position and its velocity are denoted as s_j and V_j. The learning factors are k_1, k_2 with the random number r_{andom} between (0, 1) interval. Where, $k_1 = k_2 = 2$. The position best solution and global best solution directs the j^{th} particle position based on equation (7) and update the new updated solution to find out the fitness function.

Cauchy mutation process: Mutation administrator in the discrete is required to present decent variety in the populace starting with one generation then onto the next so as to dispose of stalling out at neighborhood ideal [14]. On account of Cauchy mutation, the irregular variable is a Cauchy appropriation. The function focused on the inception is characterized by

Where $k > 0$ is a scale parameter; the Cauchy distribution function of DCMA is calculated by equation.

The Cauchy mutation is utilized to transform the people as indicated by the above condition. The mutation is performed based on pre-decided mutating probability. To acquire the achievable ideal solution, rehash the above procedure for a specific number of cycles. The number of iterations is by and large relies on the measure of issue.

Stopping criterion: The new optimal value is checked. To stop the PSOCM process while the preferred optimum value is attained else the process is again repeated from the calculation of fitness value.

IV. RESULT AND DISCUSSION

The proposed work performance is validated in this section using various experimental analyses. The i5 processors, system configuration with 4GB RAM thereby the operational stage of MATLAB 2016a execute the numerical modeling.

Table 1: Iteration based Availability Results for Proposed (PSOCM) System

FR/RR	Number of Iteration									
	10	20	30	40	50	60	70	80	90	100
α1	0.09	0.07	0.056	0.05	0.13	0.12	0.064	0.05	0.09	0.1
α2	0.05	0.08	0.042	0.05	0.08	1.023	0.08	0.09	1.02	1.06
α3	0.005	0.008	0.008	0.006	0.006	0.009	0.0024	0.009	0.075	0.089
α4	0.004	0.0052	0.0062	0.0045	0.0087	0.0085	0.006	0.66	0.065	0.065
α5	0.014	0.008	0.009	0.0056	0.0085	0.006	0.0045	0.06	0.04	0.06
α6	0.014	0.0156	0.015	0.019	0.03	0.012	0.08	0.72	0.05	0.55
α7	0.034	0.05	0.031	0.025	0.062	0.041	0.03	0.44	0.12	0.42
μ1	1.02	0.756	0.33	1.08	0.189	0.16	0.72	0.02	0.59	0.66
μ2	1.06	0.95	0.99	0.79	0.89	0.86	0.59	0.66	1.02	1.08
μ3	1.05	0.91	0.72	0.76	0.99	0.88	0.9	0.72	0.45	0.96
μ3	1.04	0.854	0.76	0.89	0.88	0.92	0.892	0.68	0.48	0.62
μ4	0.65	0.62	0.65	0.69	0.77	0.45	0.59	0.69	0.45	0.685
μ5	1.03	1.402	1.008	0.89	0.95	1.356	1.195	1.15	1.16	1.178
μ6	1.05	1.15	1.06	1.25	1.15	1.09	0.78	0.92	0.95	0.86
μ7	0.88	0.68	0.92	0.78	0.7	0.76	0.67	0.78	0.62	0.79
Availability	0.82	0.77	0.76	0.66	0.74	0.75	0.88	0.89	0.79	0.85

V. CONCLUSION

This study analyzes the availability of snacks food production industry via Markov mathematical modelling (MMM) with Particle Swarm Optimization based Cauchy Mutation (PSOCM). The seven subsystems such as Core Building Machine (CBM), Brazing machines (BM), Air Leak Testing Machine (ALT), Tungsten Inert Gas Welding (TIG), Inner Leak Testing (ILT), Helium Leak Testing Machine (HT), Foam Pasting Machine (FPM) are considered in this work. The implementation works are carried out in MATLAB platform. The MMM execute the probability distribution and provides the outcome of each sub system thereby considering exponential distribution of RR and FR of sub-systems. From this, gradually enhance in FR reduced the availability (fitness function) and further maximized in RR increasing the fitness function respectively. From the experimental investigation, the RR and FR subsystem yields superior availability performances in each sub system. While comparing to GA and PSO, the proposed MM based PSOCM accomplishes better availability rates.

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