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Study of Variations in Calibration Factor of a Charcoal Canister Based Passive ^{222}Rn Detector with Relative Humidity

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Abstract: *Many active, passive measurement techniques are used to measure the ^{222}Rn concentration around the world. The devices and detectors used for these techniques in India are most of the times factory calibrated or else calibrated in an accumulation kind of calibration chambers individually. Hence there is a need for simultaneous calibration of all these detectors at a single instant for various simulated conditions of ^{222}Rn concentration, humidity and temperature. In the present study calibration method of charcoal based detector is discussed.*

Key Words: *Radon, Charcoal, Humidity, Calibration.*

1. Introduction

Radon (^{222}Rn) is a radioactive gas that emanates from rocks and soils and tends to concentrate in the enclosed spaces like underground mines or houses. Soil gas infiltration is recognized as the most important source of residential ^{222}Rn. Other sources, including building materials and water extracted from wells, are also important in some circumstances (D. Mazur *et al*, 1999).

^{222}Rn is a decay product from the uranium (^{238}U) decay series. It is an inert gas having half-life of 3.8 days. Another member of ^{222}Rn isotope family is Thoron (^{220}Rn), having half life of 55.6 second and chemical properties same as that of ^{222}Rn. The decay products of ^{222}Rn and ^{220}Rn are the isotopes of heavy metals namely ^{x}Po, ^{x}Bi and ^{x}Pb are solid and behave as airborne particles (A. Vargas *et al*, 1990; David J. Gray, Sam T. Windham, 1987).

Many instruments and techniques are available for the measurement of ^{222}Rn, ^{220}Rn and their decay products. These measurement techniques are based on the detection of alpha, beta or gamma ray radiations emitted by them independently or in combination.

Many active, passive measurement techniques are used to measure the ^{222}Rn concentration around the world. Active monitoring devices such as

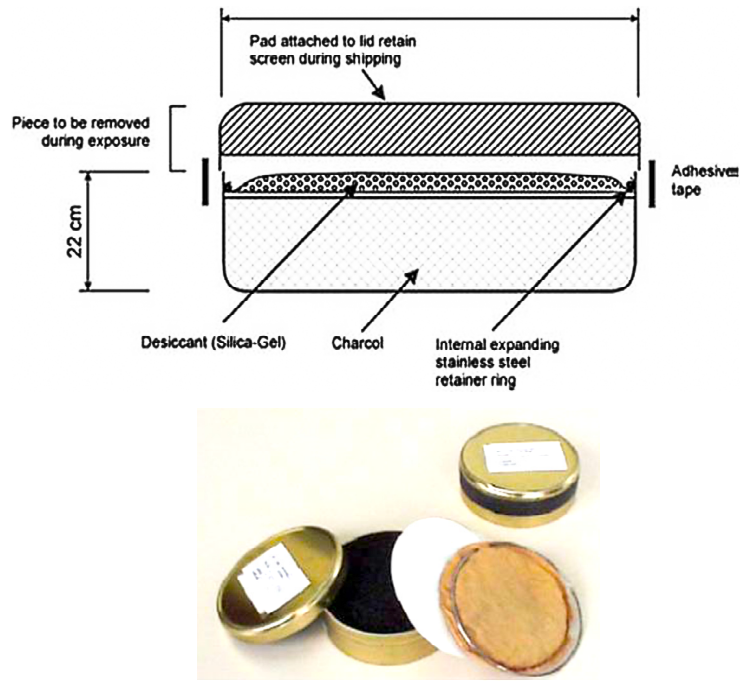
Alpha Guard, scintillation based Rn^{222}/Rn^{220} monitors (SRM, TM), RAD7 etc and passive techniques such as pinhole dosimeters, SSNTD based DTPS/ DRPS etc (Jon Miles, 2006) are widely used in India. Hence devices and detectors used for these techniques in India are most of the times factory calibrated or else calibrated in an accumulation kind of calibration chambers individually. Hence there is a need for simultaneous calibration of all these detectors at a single instant for various simulated conditions of ^{222}Rn concentration, humidity and temperature.

The present study describes the calibration of charcoal based detector. The Objective of the study is to determination of the calibration factor K for the charcoal based detectors for different exposure relative humidity conditions.

2 Materials and Methods

2.1 ^{222}Rn Canister Detector

Fig 1: Scheme and Photograph of Canister



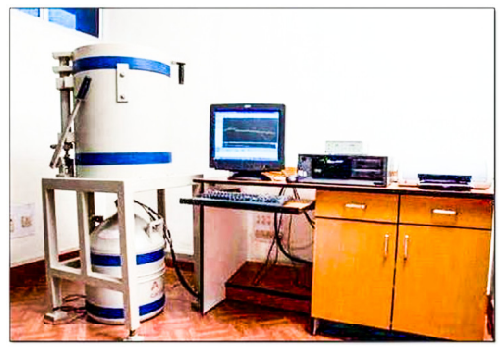
The ^{222}Rn canister detector containing 75 g of granular activated charcoal of mesh size (8 x 16 meshes) coated with a 50-g Silica Gel drier-barrier. The dimension of the canister is 4"×11/8"H. Figure 1 shows a scheme of the canister and a photograph. By counting the gamma pulses of energy for Pb-214 (295 keV, 352 keV) and Bi-214 (609 keV) in an HPGe gamma spectrometer, the amount of adsorbed ^{222}Rn in the activated charcoal is measured.

2.2 High Pure Germanium (HPGe) Detector

Hyper pure germanium detectors (Figure 2) are widely used for gamma ray spectroscopy to determine quantitatively the activities of natural ^{40}K, ^{232}Th, ^{238}U, ^{226}Ra, ^{210}Pb, & ^{137}Cs in the environmental samples. The HPGe detectors have very high resolution, but the efficiencies are low compared to those of scintillation detectors such as NaI (Tl). The high purity germanium detector can be produced from either n-type or p-type (Germanium) semiconductor materials. Since germanium has a relatively low band gap, these detectors must be cooled in order to reduce the thermal generation of charge carriers (reverse leakage current). Otherwise, the leakage current induced noise destroys the energy resolution of the detector. Therefore, the HPGe detector should always be operated at liquid nitrogen temperature (-196^{0}C or 77K).

Here we analyze the Rn^{222} absorbed canister in HPGe for 1200 seconds after a delay of 3 hours post exposure and ceiling the detectors, then the counts obtained at energy peak corresponding for Pb-214 (295 keV, 352 keV) and Bi-214 (609 keV) are used for calculating the calibration factor K.

Fig 2: A View of HPGe Spectrometer Used in Present Study



3 Experimental

The ^{222}Rn canister detector containing 75 g of granular activated charcoal of mesh size (8 x 16 meshes) coated with a 50-g Silica Gel drier-barrier. The dimension of the canister is 4"×11/8"H. Figure 1 shows a scheme of the canister and a photograph.

The calibration factor K is calculated using the following equation:

$$K = \frac{NC_{\gamma}.\lambda_{Rn}^{2}}{\varepsilon.C.(1-e^{-\lambda_{Rn}.T}).(1-e^{-\lambda_{Rn}.\Delta t}).e^{-\lambda_{Rn}.t}} \qquad (1)$$

Where NCγ- total γ-count minus the background counts, t - time from the end of the exposure period and the start of the counting period or decay time, Δt- Counting period, ε - Detection efficiency, λ_{Rn}- ^{222}Rn decay constant in s^{-1}, C_{Rn}- Activity mean ^{222}Rn concentration in chamber air during the exposure period in Bq/m^3, K - Calibration factor and represents the mean adsorption rate for ^{222}Rn during the exposure period per unit air ^{222}Rn concentration (expressed in Bqs^{-1} per Bqm^{-3} or m^3s^{-1}).

In the present study a set of exposures under different environmental conditions were done in response to relative humidity, temperature and ^{222}Rn concentration. The charcoal adsorption technique is widely used to measure indoor ^{222}Rn concentration for periods of 2-7 days. Such short term measurements are commonly carried out in order to provide both cost effective and rapid results. During the exposure time, ^{222}Rn is continually adsorbed and desorbed. The adsorption and desorption process depends on several factors. The most important is the air humidity since charcoal adsorbs water and ^{222}Rn atoms have fewer sites to be adsorbed.

3.1 General Protocol for Calibration

At least 10 dosimeters of each type should be placed in the chamber for exposure. Using a suitable source, ^{222}Rn concentration in the chamber is generated to required level. Other parameters of the chamber such as humidity, temperature and fan off – on conditions are also set as per the requirements. Dosimeter exposure duration varies from 3-7 days. Charcoal canisters here were exposed for 3 days as the exposure duration selected is justified to account for unexplainable variations in measurements. Once the exposure duration is complete, dosimeters are processed and monitor data is analyzed, respective calibration factors and percentage of deviation from the set values

in case of online monitors are given (J. Bogacz, *et al* 2001; Lalmuanpuia Vanchhawng, 2012)

^{222}Rn detectors should be calibrated annually in a qualified ^{222}Rn chamber. The ^{222}Rn chamber exposures should be done at different ^{222}Rn concentrations and with various environmental conditions as humidity, temperature and exposure duration. This should be done periodically and specifically before a new batch of charcoal is put into use. The data obtained should be compared to the data originally for quality assurance purposes.

In order to evaluate the influence of relative humidity over the calibration factor of ^{222}Rn for the charcoal based detectors, 4 exposures inside the ^{222}Rn chamber were carried out under different humidity conditions ranging from 50% to 80%, keeping the ^{222}Rn concentration fixed at ~ 10000 Bqm^{-3} and temperature at 28^{0}C. In each run at set of 6 canisters & vials were exposed for a period of 3-days at certain fixed positions in the chamber. The exposed canisters and vials are sealed and then analyzed using HPGe gamma spectrometer, after placing for a delay period of 3 h in order to ^{222}Rn attain secular equilibrium with its daughter products.

By counting the gamma pulses of energy for Pb-214 (295 keV, 352 keV) and Bi-214 (609 keV) in an HPGe gamma spectrometer, the amount of adsorbed ^{222}Rn in the activated charcoal is measured in units of Becquerel. Which then upon substitution in the equation (1) along with the decay terms and ^{222}Rn concentration maintained in the chamber, gives the values of the calibration factor K. Similarly the detectors are exposed at different relative humidity values and the calibration factor is calculated each time. Mass gained by the detectors is also measured during all the exposures and its dependency over the exposure relative humidity is analyzed by deducing a correction factor to the calibration factor. The exponential fit to the curve representing variations in calibration factor K versus mass increment Δm for the respective value of relative humidity gives the correction factor.

3.2 Specifications of the Chamber Used for Calibration

In order to study the variations of the calibration factor with humidity, the canisters were exposed to controlled environmental conditions in a walk in ^{222}Rn calibration chamber installed at CARER, Mangalore University (figure 3). The specifications of the chamber are given in the Table. 1 below (Paul Kotrappa and Frederick Stieff, 2007)

Table 1: Specifications of the Chamber Used for Calibration

Volume	22.7 m^3
Dimensions	3 m (*l*) × 2.75 m (*w*) × 2.75 m (*h*)
Temperature control range	5 °C – 50 °C
Relative humidity control range	30 % - 95 %
Inlet gas ports	5
Exhaust gas ports	1
Sampling ports	5
Chamber wall composition	Double walled SS sheets with 100 mm thick thermal insulation of polyurethane foam filled in between the sheets.
Detectors/ instrument placers	SS platforms, holders & rods
Humidifier	Ultrasonic & boiler type humidification system
Dehumidifier	Refrigerated coil type
Temperature controller	Heated and refrigerated coils

In three of the four chamber walls there are access ports in order to take air samples, ventilate the chamber and for the necessary electrical connections.

Fig 3: Walk in Type ^{222}Rn Calibration Chamber

The reference instruments for the ^{222}Rn concentration measurements in the chamber are ionization chamber based Alpha Guard and scintillation cell based RnDuo, whereas soil gas is used as ^{222}Rn source.

4 Results and Discussions

In tables given below the different environmental conditions in the ^{222}Rn chamber for each exposure and the calibration factor estimation are presented. For each exposure calibration factor K has been estimated using equation (1). Four exposures were carried out in order to evaluate the effect of relative humidity on the calibration factor. Charcoal canisters and vials were exposed to relative humidity of 50%, 60% and 80%. Rn^{222} concentration and temperature are almost same for each exposure, while relative humidity varies from 50% to 80%. Calibration was done by maintaining a constant temperature of 28^0C.

Table 2: Environmental Conditions in the ^{222}Rn Chamber for Each Exposure and the Calibration Factor Estimation for Charcoal Canister

Relative humidity (%)	^{222}Rn Calibration factor $K*10^{-11}(m^3s^{-1})$	Mass increment in the canister after exposure Δ m(g)
50	7.96	2.0885
60	8.20	6.9000
80	2.19	18.871
Environmental exposure	13.1	3.3630

Table 3: Environmental Conditions in the ^{222}Rn Chamber for each Exposure and the Calibration Factor Estimation for Vials.

Relative humidity (%)	^{222}Rn Calibration factor $K*10^{-11}(m^3s^{-1})$	Mass increment in the vials after exposure Δ m(g)
60	1.70	0.3500
80	0.177	0.6200
Environmental exposure	1.39	0.0705

Fig 4: Correlation Plot Showing Variation in Calibration Factor K with Relative Humidity for Charcoal Canister.

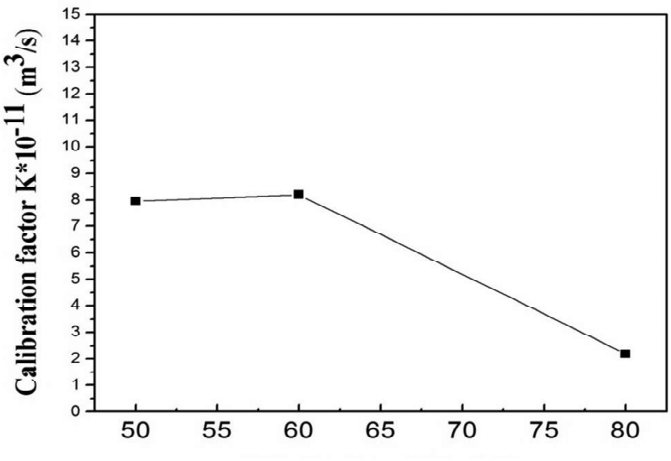
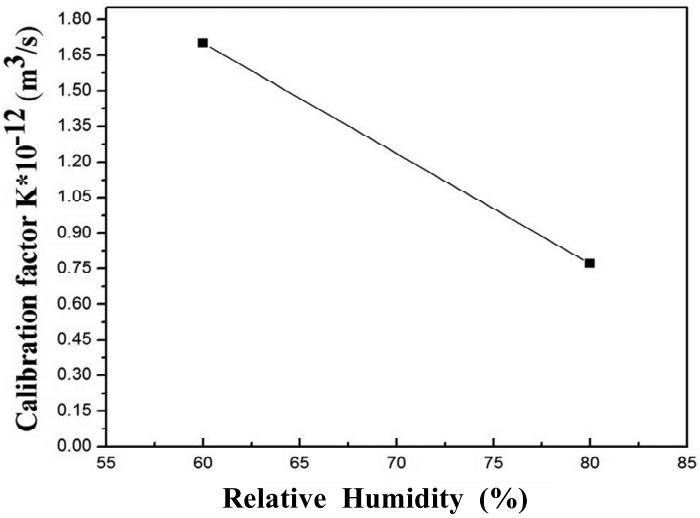


Fig 5: Correlation Plot Showing Variation in Calibration Factor K with Relative Humidity for Vials.



From the Figure 4 and 5 we can infer that as the relative humidity increases the pores of the charcoal gets filled with moisture, which impairs its capacity to adsorb ^{222}Rn as the result the calibration factor values decreases with increase in the relative humidity at exposure. The calibration factor obtained in case of vials is smaller by an order than that of canister and this is due to the fact that canister have higher amount of charcoal and greater surface area of exposure when compared to vials.

From Table 2 and Table 3 it is evident that a variation of the calibration factor K with relative humidity and variations in mass increment (Δm) in the detector with relative humidity is occurring. Hence a correction factor due to mass increment needs to be incorporated in addition to calibration factor; this is also suggested in the calibration experiments carried out described in Vargas *et al* 2006 and a relation of the kind as expressed in the following is expected.

$K = 1.363\times10^{-6}e^{-0.01225\,\Delta m}$, where Δm is the mass increase during the exposure period in grams and accordingly the correction factor is estimated for the detectors. This procedure of fitting exponentially to deduce the correction factor needs some more experimental results, and is not discussed in this article.

5 Conclusion

Calibration of passive activated charcoal based Rn^{222} detectorsis done in a walk in calibration chamber installed at CENTRE FOR ADVANCED RESEARCH IN ENVIRONMENTAL RADIOACTIVITY (CARER), Mangalore University. Similarly periodic calibrations can be done for different kind of detectors used for Rn^{222} measurements in the facility before its field validation.

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A Study of ^{14}C Concentration in Different Environmental Matrices Around Western Ghats

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Abstract: *Carbon-14 (^{14}C) is a radioactive carbon isotope present in infinitesimal quantities in the atmosphere. Carbon-12 and Carbon-13 are the stable carbon isotopes and respectively represent 98.9% and 1.1% of the total Carbon. Carbon-14 only exists in trace quantities. It is an important radioactive isotope to be monitored because of its long half-life, environmental mobility and ease of assimilation into living matter. The present study would provide a reliable database on ^{14}C concentration in some of the environmental matrices around Western Ghats region.*

Key Words: *Pyrolyser, Liquid Scintillation Counter, Carbon-14, Western Ghats.*

1. Introduction

Carbon-14 (^{14}C) is a radioactive carbon isotope present in infinitesimal quantities in the atmosphere. Carbon-12 and Carbon-13 are the stable carbon isotopes and respectively represent 98.9% and 1.1% of the total Carbon. Carbon-14 only exists in3 trace quantities. The chemical forms of ^{14}C vary according to the method of production. In the environment, ^{14}C exists in two main forms:

- As $^{14}CO_2$, it acts as stable carbon dioxide, which means it can remain in gas form in the air, becoming bicarbonate and carbonate in water (Killough G.G., Rowher P.S., 1978)
- During photosynthesis, $^{14}CO_2$ is incorporated in the organic material, forming its carbon skeleton. Equilibrium between the specific activity of the atmospheric carbon and the organic material is then finally reached and maintained by carbon recycling (Cain W. F., Suess H. E., 1976).

  Carbon has 15 isotopes with masses of 8 to 22. Only isotopes 12 and 13 are stable. Carbon 14 is a β emitter, gives rise to stable ^{14}N with 100% yield.

Origins

Natural origins

Natural ^{14}C results from cosmic neutrons acting on nitrogen atoms in the stratosphere and in the upper troposphere ($^{14}N + n \; ^{14}C + {}^{1}p$). The annual production level is around 1.40 x 10^{15} Bq and the atmospheric stock of carbon-14 at equilibrium is around 140 x 10^{15} Bq (Libby W.F., 1946)

Artificial Origins

Fallout from atmospheric nuclear explosions

During nuclear explosions, the emitted neutrons interact with atmospheric nitrogen, as cosmic neutrons do, to form carbon-14, according to the same reaction as above: $^{14}N + n \; ^{14}C + {}^{1}p$. (UNSCEAR Report A/AC. 82/G/L. 1381)

Nuclear Reactor Releases

In nuclear reactors, carbon-14 is produced from reactions in the fuel, the core structural materials and the moderator. The production rate depends upon the spectrum and neutron flux, on cross – sections and on the concentration of the following target elements: uranium, polonium, nitrogen and oxygen (Karin A., Bengt H., 2005; Levin I., *et at*, 1988).

Various sources (medical, industrial and research)

In research, carbon-14 is widely used in carbonate form for isotopic labeling of molecules. The activities used are greater than 1 GBq. For example, carbon - 14 is used to study the metabolic dysfunction related to diabetes and anemia. It can also be used as a marker to track the metabolism of new pharmaceutical molecules (Sheppard S.C., *et al*, 2006).

Environmental Toxicity

Radio Toxicity of the Radioactive Isotope ^{14}C

Emitting β radiation with a half-life of 5,730 years, Carbon 14 follows the cycle of the stable element C, one of the components of the living materials, in which it is diluted. Carbon-14 is indeed around 10^{-12} times less abundant than stable carbon. The main source of exposure is due to naturally occurring ^{14}C (cosmogenic origin).

Carbon-14 is a low β emitter, with a low penetrating power which causes radiation stress mainly due to internal irradiation, if the ^{14}C is incorporated. Carbon-14 is interesting from a radiobiological standpoint because it is integrated in cellular components (proteins, nuclei acids), particularly cellular DNA. The resulting DNA damage involving molecular breaks, may lead to the cell death or induce potentially inheritable mutations (NCRP Report No. 81, USA. 1985).

2 Methodology

2.1 RADDEC Pyrolyser

Fig 1(a): RADDEC Pyrolyser Trio TM at CARER, Mangalore University.

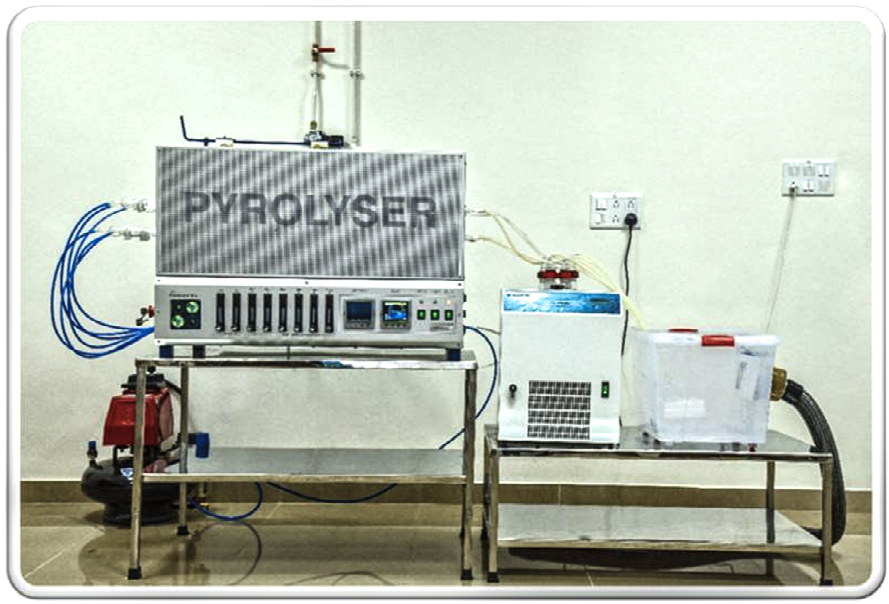


Fig 1(b): A View of RADDEC Pyrolyser Trio ™ System

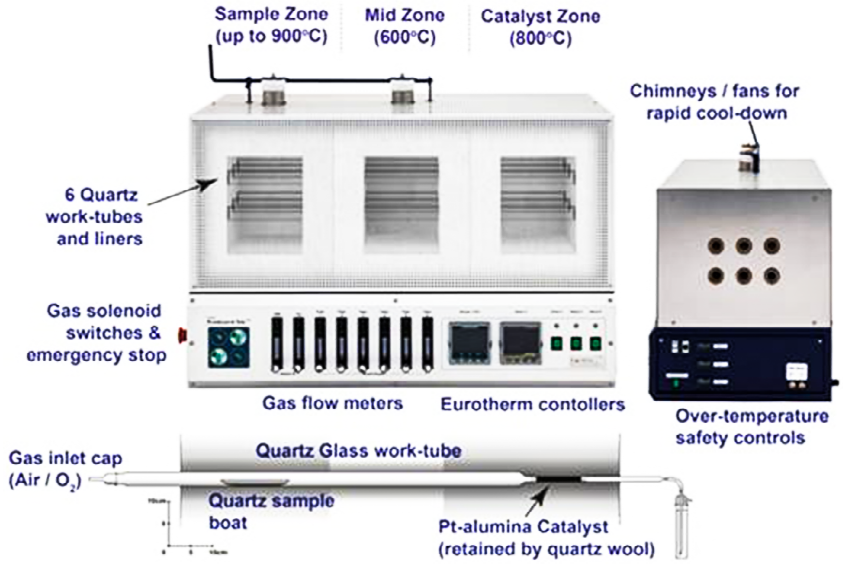
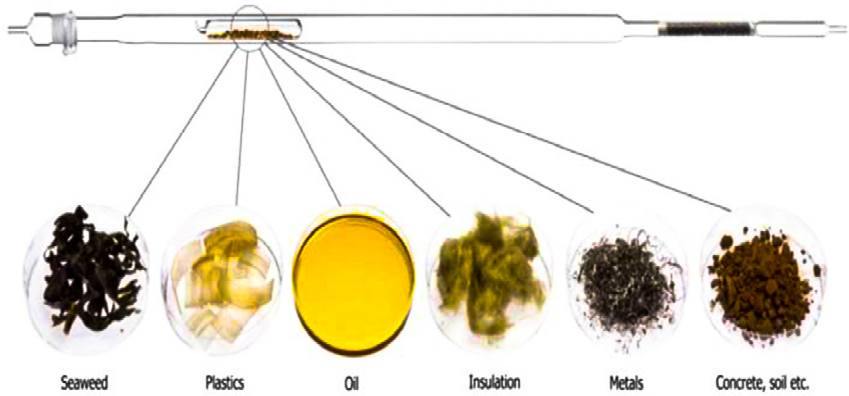


Fig 1(c): A View of Pyrolyser Work Tube and Samples to be Taken for Analysis



Environmental samples of interest are combusted by thermal oxidation method using a Pyrolyser Trio system for separation of carbon from the sample (RADDEC, UK, Fig. 1). Pyrolyser is a fully integrated triple-zone furnace system that incorporates six work-tubes (silica) for simultaneous extraction of ^{14}C and ^{3}H from six different samples. Samples of environmental matrix were oven dried at 80 ^{O}C till complete moisture from the samples was removed. They were then powdered using a sample crusher and evenly spread in a silica sample boat. The silica boat is then placed within the silica glass work tube in sample zone of the furnace and heated under controlled condition. There are eight predefined programs stored in the memory of Pyrolyser system. In addition to this the user can develop/define a program depending upon the specific requirements. Each predefined program differs with the heating temperature; ramp and hold time and is meant for combustion of different types of samples. Normally, for samples such as leaves, fruit and vegetables, the ORGANIC program is selected and for samples such as sediment, soil and sand, NORMAL program is selected.

During the initial heating period, air at a flow rate of 0.1 l pm is passed through the heating tube using an air compressor. Once the temperature of the sample zone reaches to 500^{o}C, oxygen is introduced to accelerate oxidation of the remaining sample. The heating cycles are programmed to ensure controlled and complete oxidation of organic-rich samples at low temperatures and prevent sudden pressure excursions within the work tube. The liberated gases pass through a catalyst zone which is filled with 10g of Platinum-Alumina catalyst pellets to oxidize any organic combustion products to CO_2 and H_2O (HTO). Any water vapour, including HTO, is trapped in a bubbler which is placed in the cryo-cooler (temperature maintained is -110^{o}C) and CO_2 gets trapped in the bubbler containing 20 ml of Carbon Trap, which is an amine with trapping efficiency of ~96%. After the complete combustion of the sample, an aliquot of 10 ml carbon trap from the bubbler is mixed with 10 ml of scintillation cocktail (Carbon Count). After mixing, the samples were stored in dark for overnight so that chemi-luminescence is removed. The samples are then analyzed for ^{14}C activity in Quantulus 1220 Liquid Scintillation Spectrometer (Perkin Elmer, USA).

2.2 Auantulus 1220 LSC

The QUANTULUS Liquid Scintillation Spectrometer is a beta counter dedicated to ultra low level counting: the thicker shield eliminates effects of

cosmic radiations and consequently reduces background. This makes the QUANTULUS Liquid Scintillation Spectrometer a good choice for Carbon-14-dating (Lim J.M., *et al*, 2015; Tzu-Han Chuang, *et al*, 2015).

Because of the extremely low natural levels of radiocarbon in the earth's atmosphere (about 1 x 10^{-10} %), accurate measurement of ^{14}C is not an easy task. These difficulties are further compounded, by the influence of cosmic and environmental background radiation, other radioisotopes being present, electronic noise and instability, and other factors. These background factors limit the accuracy, precision, and range of the radiocarbon dating method because finite ages can only be calculated where sample activity is at least 3 standard deviations above background activity (Gupta and Polach, 1985). Consequently, each of the components of the LS counting system needs to be totally optimised for low-level counting, so as to maintain high counting efficiency whilst significantly reducing the background. The 'total optimisation concept' (Polach, 1987; p.8) has been applied in the design of the Perkin Elmer 1220 Quantulus.

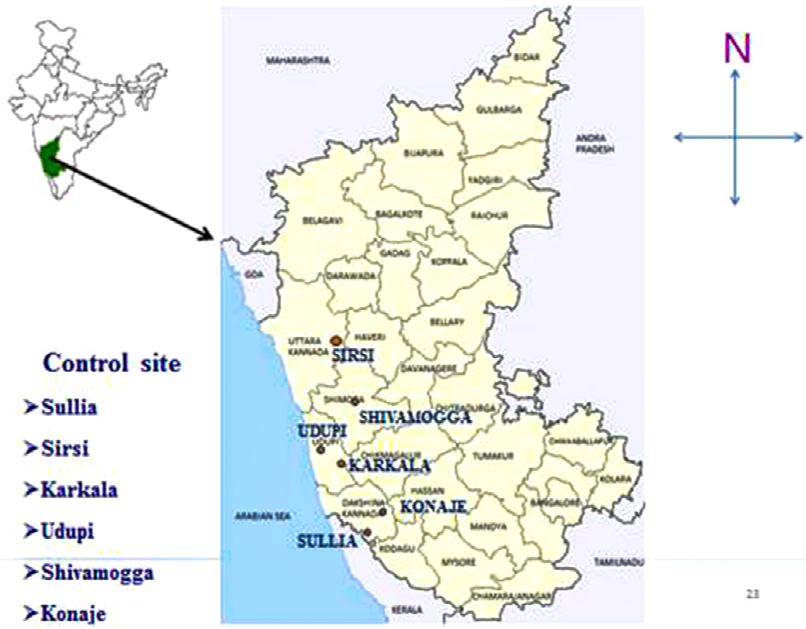
Fig 3: Diagram of Quantulus 1220 LSC from CARER

Sample Handling

The counting vial is placed into one of three trays located beneath the shield, and counting data (tray position number, 1-60; sample identification number; counting requirements etc) entered into a laboratory computer. The LS vial is housed in a stepped stainless steel sleeve, which forms a light seal when the sample is loaded through the bottom of the shield assembly, by a low activity copper piston. The sample changer and shield areas are refrigerated to reduce the benzene evaporative loss, and also ventilated, to prevent condensation on vials and to eliminate possible radon build-up.

2.3 Sample Collection

Fig 4: Locations from where samples have been collected



The plant samples such as leaves, vegetables, leafy vegetables and fruits were collected from different locations like Udupi, Mangalore, Sullia, Mala, Shindli and Telagundi.

Table 1: Location of samples

Place	Longitude and Latitude
Udupi	13.3409°N, 74.7421°E
Mangalore	12.9141°N, 74.8560°E
Sullia	12.5581°N, 75.3908°E
Mala	13.2151°N, 74.9961°E
Shindli	14.4905°N 74.9265°E
Telagundi	14.5083°N 74.9150°E

Table 2: Biological Name of Collected Samples

Samples	Biological Names
Banana Leaves	*Musa acuminate*
Banana Fruit	*Musa acuminate*
Guava Fruit	*Psidium guajava*
Papaya Fruit	*Carica papaya*

Leaf Samples

Collected 0.5 kg of fresh tree leaves from the selected location and placed inside a polythene bag, labeled and sealed properly. After bringing the sample to the laboratory, the sample is weighed and stored in the refrigerator till it is taken up for processing.

Fruits

Collected 0.5 kg of fruits straight from the garden and wiped the fruits clean and placed them inside a polythene bag, labeled and sealed properly. After bringing the sample to the laboratory, stored the sample in the refrigerator till it is taken up for processing.

2.4 Sample Preparation

Leaf Samples

The tree leaf samples were taken out of the refrigerator and noted the wet weight. The sample was dried at 80°C, in an oven till complete moisture

from the sample is removed. The dry weight is noted. The oven dried samples are finely powdered using sample crusher and powdered samples are stored in an air tight polythene container.

Fruits

Stored fruit samples were taken out of the refrigerator. Removed the non-edible portions like seed, skin etc., from the sample and noted the wet weight. The sample was dried at 80°C in an oven till complete moisture from the sample is removed and the dry weight was noted. Next the oven dried samples were finely powdered using sample crusher.

Fig 5: Fresh Banana Fruit Sample

Fig 6: Powdered Banana Fruit Sample

Fig 7: Dried Samples Ready for Combustion

2.5 Sample Processing

At Center for Advanced Research in Environmental Radioactivity (CARER), the environmental samples are combusted by thermal oxidation method (using a Pyrolyser Trio system from RADDEC, UK) for separation of carbon from the sample.

Different leaf and fruit samples from various locations were collected. These were then powdered using a sample crusher and placed in the silica glass work tube within the sample zone of the Pyrolyser and combusted using ORGANIC program in the pyrolyser. The liberated gases during the combustion process are passed through a catalyst zone which is filled with 10 g of Pt-Alumina catalyst pellets to oxidize any organic combustion products to CO_2 and H_2O (HTO). Any water vapour, including HTO, is trapped in a bubbler which is placed in the cryo cooler (temperature maintained is -110^oC) and CO_2 gets trapped in the bubbler containing 20 ml of carbon trap, which is an amine. After the complete combustion of the sample, an aliquot of 10 ml carbon trap from the bubbler is mixed with 10 ml of scintillator and counted in LSC.

LSC Calibration

The sample and standard should have same window settings. Since quenching will affect the spectrum, standard should be prepared in the similar matrix with respect to physical and chemical properties. Also standard should have the same sample to cocktail ratio. Using proper standards calibrate the analyser and estimate the efficiency of C-14.

Counting Time

Counting time for background, sample and standard is 500 min, 300 min and 20 min respectively.

3 Results and Discussion

As mentioned above the plant samples in the form of leaves and fruits were collected and combusted in the RADDEC Pyrolyser to determine the ^{14}C concentration in the particular samples. The values obtained are given as follows:

Leaf Samples

Table 3: Activity of Leaf Samples

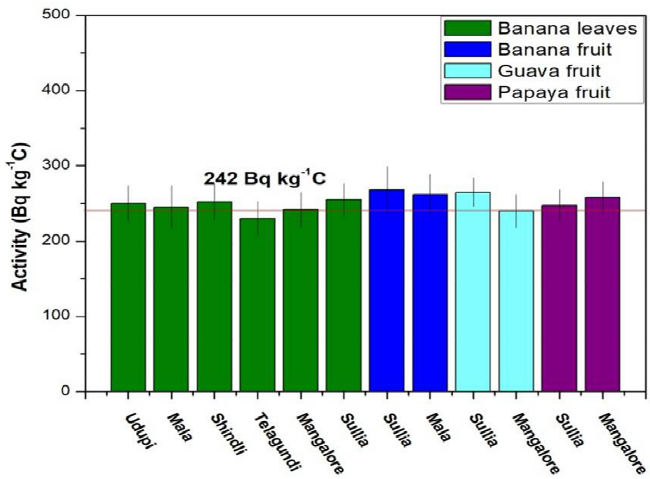
Sample name	Place	Activity ± SDBq $kg^{-1}C$
Banana Leaves	Udupi	250±24
Banana Leaves	Mala	245±29
Banana Leaves	Shindli	252±24
Banana Leaves	Telagundi	230±23
Banana Leaves	Mangalore	242±23
Banana Leaves	Sullia	255±21

Fruit Samples

Table 4: Activity of Fruit Samples

Sample name	Place	Activity ± SDBq $kg^{-1}C$
Banana	Sullia	268±31
Banana	Mala	262±26
Guava	Sullia	265±19
Guava	Mangalore	240±22
Papaya	Sullia	247±21
Papaya	Mangalore	258±21

Fig 11: ^{14}C Concentration in Different Leaf and Fruit Samples from Various Locations



The calculated ^{14}C concentration in different leaf and fruit samples from region covering 4 districts show that the values match well with the worldwide ^{14}C Concentration. Minute increase in the ^{14}C concentration may be due to the various processes involved in the processing. The standard deviation will take care of the increase in the calculated value of ^{14}C concentration.

Estimation of Activity

Following equation must be used to estimate the activity in the sample.

$$A = \frac{(C_s - C_b)}{60 \times E \times Y \times W \times C}$$

Where A is the activity in the sample (Bq $kg^{-1}C$), Cs is the sample count rate obtained in the sample (Counts/m), C_b is the background count rate (Counts/m), Y is recovery factor, E is fractional counting efficiency derived from SQP(E) of the sample (derived from the quench curve), W is the weight (kg) of the sample taken for analysis, C is the fractional carbon percent of the sample.

Estimation of MDA: Minimum detectable activity of particular radionuclide of a particular system. MDA is calculated using below equation.

$$MDA = \frac{4.56 \times \sqrt{C_b}}{60 \times E \times W \times C \times T \times Y}$$

Where C_b is the background count rate (Counts /m), E is fractional counting efficiency derived from SQP(E) of the sample (derived from the quench curve), W is the weight (kg) of the sample taken for analysis, C is the fractional carbon percent of the sample, T is the counting time in minutes, Y is recovery factor.

For 1 g of a sample, counted in LSC for 300 min. with 52% counting efficiency, MDA achieved for ^{14}C using Pyrolyser – LSC method is 11 Bq $kg^{-1}C$. Worldwide ^{14}C background concentration is ~ 242 Bq $kg^{-1}C$. Pyrolyser-LSC method is capable of measuring ^{14}C concentration ~20 lower than the background concentration.

4 Conclusion

The carbon-14 concentration in different fruit and leaf samples from various locations of Dakshina Kannada, Uttara Kannada, Udupi region were measured using Pyrolyser - LSC method at Centre for Advanced Research in Environemtal Radioactivity (CARER), Mangalore University. The mean values of carbon-14 concentration in Banana leaves is found to be 246±9 Bq $kg^{-1}C$; similarly for Banana fruit, ^{14}C concnentration is found to be 265±4 Bq $kg^{-1}C$. ^{14}C concnentration for Guava and Papaya fruit is found to be 253 ±18 Bq $kg^{-1}C$ and 252 ±8 Bq $kg^{-1}C$ resepectively.

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Fermat's Last Theorem for the Case $n = 3$

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Abstract: *Fermat's Last Theorem is one of the most difficult and famous problems in mathematics which was unsolved for more than 350 years. Fermat himself proved the theorem for the case n=4. Leonardo Euler gave the proof for the first odd prime number 3. But his proof was not complete. It contained a fallacious argument which he didn't recognize. To correct it by the most direct method, that of supplying an alternative proof of the statement for which Euler's proof is fallacious is not at all simple. Here in this paper we show how the proof can be corrected in a less direct way by bringing in arguments which Euler used to prove other propositions of Fermat. Thus we get a complete proof of the theorem for the case n=3.*

Key words: *Divisors, Factors, Cube, Prime, etc.*

Introduction

Fermat's last theorem was one of the very famous theorems which attracted the famous mathematicians of all times. Among all the famous theorems in the number theory Fermat's last theorem stands first being a theorem stated by a non mathematician by profession, Pierre De Fermat and proved by Andrew Wiles, three centuries after it was stated. Fermat's last theorem was recorded in Guinness Book of records as the "most difficult mathematical problems" being the theorem having largest number of unsuccessful proofs. The unsolved problem stimulated the development of algebraic number

theory in the 19th century and the proof of the modularity theorem in the 20th century. It is among the most notable theorems in the history of mathematics. Fermat's last theorem states that, no three positive integers a, b, and c satisfy the equation $x^n + y^n = z^n$ for any integer value of n greater than 2. This theorem was first conjectured by Pierre De Fermat in 1637 in the margin of a copy of Arithmetica where he claimed he had a proof that was too large to fit in the margin.

Euler was one of the great mathematicians of the times and he had interest in every field of mathematics. And here in this paper we study the contributions of Euler for the proof of Fermat's Last Theorem. The basic method of Euler's proof of the case $n = 3$ Fermat's method of infinite descent. He shows that if positive whole numbers x, y, z could be found for which $x^3 + y^3 = z^3$ then smaller positive whole numbers could be found with the same property, thus it would be possible to find a sequence of such triples of positive integers which continually decreased and never terminated, which is manifestly impossible. Therefore no such x, y, z can be found.

Euler's Proof of the Case n = 3

Let

$$x^3 + y^3 = z^3 \tag{1}$$

Step 1: Any factor which divided two of the numbers x, y, z would, by virtue of this equation, also divide the third. Therefore all common factors can be removed and one can assume at the outset that the numbers x, y, z are pairwise relatively prime. In particular, then, at the most one of the three numbers x, y, z is even. On the other hand, at least one is even because if x, y are both odd then z is even. Therefore exactly one is even.

Case 1: x, y are odd and z is even.

Then $x + y$ and $x - y$ are both even, say $2p$ and $2q$ respectively

$$\Rightarrow x = p + q, \qquad y = p - q$$

.

We have

$$\begin{aligned} & x^3 + y^3 = (x + y)(x^2 - xy + y^2) \\ \Rightarrow \quad & x^3 + y^3 = 2p[(p + q)^2 - (p + q)(p - q) + (p - q)^2] \\ & \qquad = 2p(p^2 + 3q^2) \end{aligned}$$

Since $p + q$ and $p - q$ are odd, p and q are of opposite parities. And they are relatively prime because any factor they had in common would divide both $x = p+q$ and $y = p-q$, and therefore could only be 1.

Moreover, p and q can both be assumed to be positive.

Therefore the assumption that $x^3 + y^3 = z^3$ is possible with x, y both odd, which implies that there exist relatively prime positive integers p, q of opposite parity such that

$$2p(p^2 + 3q^2) = cube$$

.

***Case 2**: z is odd and x or y is even .*

Let x be even and y and z be odd.

$$\begin{aligned} & \Rightarrow x^3 = z^3 - y^3 = (z - y)(z^2 + zy + y^2) \\ & Then, \quad z - y = 2p, \quad z + y = 2q, \quad z = p + q, \quad y = q - p \\ & And \quad x^3 = 2p[(q + p)^2 + (q + p)(q - p) + (q - p)^2] \end{aligned}$$

which leads to the same conclusion that $2p(p^2 + 3q^2) = cube$ where p, q are relatively prime positive integers of opposite parity.

Similarly we can reach at same conclusion if x is odd and y is even.

Step 2: Since p and q are of opposite parity $(p^2 + 3q^2)$ is odd.

Any common factor of $2p$ and (p^2+3q^2) would be a common factor of p and (p^2+3q^2) and therefore a common factor of p, $3q^2$.
Since $gcd(p,q) - 1$, this implies that the only possible common factor is 3.
But if $3 \mid p \Rightarrow 3 \mid (p^2+3q^2)$,then $2p$ and (p^2+3q^2) are not relatively prime.
The proof therefore splits into two cases, the one in which $3 \nmid p$ and consequently $gcd(2p, p^2+3q^2) = 1$ and the other in which $3 \mid p$.

Case 1: $3 \nmid p$ and consequently $2p$ and $(p^2+3q^2)$are relatively prime
Assume that 3 does not divide p and that $2p$ and (p^2+3q^2) are both cubes.
First we show that there exists two values a and b such that $p = a^3 - 9ab^2$ and $q = 3a^2b - 3b^3$ with $gcd(a,b) = 1$ and a and b are of opposite parity.
We have $(a^2+3b^2)(c^2+3d^2) = (ac-3bd)^2 + 3(ad+bc)^2$
Consider ,

$$(a^2+3b^2)^3 = (a^2+3b^2)(a^2+3b^2)(a^2+3b^2)$$
$$(a^2+3b^2)^3 = (a^2+3b^2)((a^2-3b^2)^2 + 3(ab+ba)^2)$$
$$(a^2+3b^2)^3 = (a(a^2-3b^2) - 3b(2ab))^2 + 3(a(2ab) + b(a^2-3b^2))^2$$
$$(a^2+3b^2)^3 = (a^3-9ab^2)^2 + 3(3a^2b-3b^3)^2$$

Which is of the form p^2+3q^2 where $p = a^3-9ab^2$ and $q = 3a^2b-3b^3$
$\therefore$ one way to find cubes of the form p^2+3q^2 is to choose a,b at random and set, $p = a^3 - 9ab^2$ and $q = 3a^2b - 3b^3$, so that

$$p^2 + 3q^2 = (a^2+3b^2)^3$$

.
The major gap to be filled in Euler's proof is the proof that *this is the only way that* p^2+3q^2 *can be a cube*, that is, if p^2+3q^2 is a cube then there must be a, b such that p and q are given by the above

equations.
Assuming this fact we can proceed further as follows:
We have $p = a(a-3b)(a+3b)$ and $q = 3b(a-b)(a+b) \Rightarrow gcd(a,b) = 1$
Moreover, $2p = 2a(a-3b)(a+3b) = cube.$
The parities of a and b must be opposite.
Therefore $a-3b$, $a+3b$ are both odd and the only possible common factor of $2a$, $a+3b$ would be common factors of a, $a+3b$ and therefore of a,$3b$. Similarly, any common factor of $a+3b$ and $a-3b$ would be a factor of a and $3b$.
The only possible common factor is 3.
But $3 \nmid a$ because if it did it would divide p, contrary to assumption.
Therefore $2a$, $a-3b$, $a+3b$ are relatively prime and all three of them must be cubes, say $2a = \alpha^3$,$a-3b = \beta^3$,$a+3b = \gamma^3$
Then $\beta^3 + \gamma^3 = 2a = \alpha^3$ and this gives a solution of $x^3 + y^3 = z^3$ in smaller numbers than the original solution.
Therefore the descent has been accomplished in the case where $3 \nmid p$.

***Case 2*:** $3 \mid p$ and consequently $2p$ and $(p^2+3q^2)$are not relatively prime.
Then $p = 3s$ for some positive integer s and $3 \nmid q$.
Consider,

$$\begin{aligned} 2p(p^2+3q^2) &= 3.2s(3^2s^2+3q^2) \\ &= 3^2.2s(3s^2+q^2) \end{aligned}$$

Where $gcd[(3^2.2s),(3s^2+q^2)] = 1$ thus $(3^2.2s)$ and $(3s^2+q^2)$ are cubes.
By the above assumed fact $3s^2+q^2$ can be a cube only if

$$q = a(a-3b)(a+3b) \quad and \quad s = 3b(a-b)(a+b)$$

.
Since $3^2.2s$ is a cube, $3^3.2b(a-b)(a+b)$ a cube.

$\therefore b(a-b)(a+b)$ is a cube.
And $gcd(2b,(a-b),(a+b))-1$ $\therefore$they are cubes.
Let $2b=\alpha^3$,$(a-b)=\beta^3$,$(a+b)=\gamma^3$
Remaining proof follows by case1 of step 2. To complete the proof it remains to show that if p, q are relatively prime integers such that p^2+3q^2 is a cube then there must be integers a and b such that $p=a^3-9ab^2$ and $q=3a^2b-3b^3$. To get the above conclusion Euler used the set $\{a+\sqrt{(-3)}b : a,b\in\mathbb{Z}\}$ which forms a ring with unit.

Euler's Argument for Sufficient Condition for p^2+3q^2 to be a Cube

The sufficient condition: By factorizing and applying conjugate we get that in order to find a cube of the form p^2+3q^2 it suffices to set $p+q\sqrt{(-3)}=(a+b\sqrt{(-3)})^3$. Using the binomial theorem, it follows that in order to write p^2+3q^2 as a cube it suffices to find integers a and b such that $p=a^3-9ab^2$ and $q=3a^2b-3b^3$.
Now it remains to prove the necessary condition.

Remainder of the Proof

Euler's idea of computing with numbers of the form $a+b\sqrt{(-c)}$ is closely related to the use of the formula

$$(x^2+cy^2)(u^2+cv^2)=(xu-cyv)^2+c(xv+yu)^2$$

To prove the lemma needed to prove Fermat's Last Theorem in the case n = 3 we require to prove few of the following Propositions,

Proposition 1. *If a number which is a sum of two squares is divisible by a prime which is a sum of two squares then the quotient is a sum of two squares.*

Proof: Suppose $a^2 + b^2$ is divisible by $p^2 + q^2$ and that $p^2 + q^2$ is prime, then $p^2 + q^2$ divides $(pb - aq)(pb + aq) = p^2b^2 - a^2q^2$
$\Rightarrow (pb - aq)(pb + aq) - p^2(a^2 + b^2) - a^2(p^2 + q^2)$.
Since it is prime it must divide either $pb - aq$ or $pb + aq$.
Suppose $p^2 + q^2 \mid pb + aq$, then it follows that $p^2 + q^2 \mid (ap - bq)^2$.
Therefore the equation can be divided by the square of $p^2 + q^2$ and the result is an expression of $(a^2 + b^2)/(p^2 + q^2)$ as a sum of two squares as required. The second case, in which $p^2 + q^2$ divides $pb - aq$, can be handled in the same way.

Proposition 2. *If a number of the form $a^2 + 3b^2$ is divisible by 2 then it must be divisible by 4, and its quotient by 4 must itself be of the form $c^2 + 3d^2$.*

Proof: If a and b have opposite parities then $a^2 + 3b^2$ is not divisible by 2. If a and b are both even, then $a^2 + 3b^2$ is divisible by 2^2 and the quotient is of the form $c^2 + 3d^2$ with $c = \frac{a}{2}, d = \frac{b}{2}$.
Consider the case where a and b are both odd.
Then $a = 4m \pm 1$ and $b = 4n \pm 1$ when m and n and the signs are properly chosen. Therefore either $a + b$ or $a - b$ is divisible by 4.
If $a + b$ is divisible by 4 then

$$\begin{aligned} 4(a^2 + 3b^2) &= (1^2 + 3.1^2)(a^2 + 3b^2) \\ &= (a - 3b)^2 + 3(a + b)^2 \end{aligned}$$

is divisible by 4^2 and it follows that $(a^2 + 3b^2)/4$ is of the form $c^2 + 3d^2$.
If $a - b$ is divisible by 4 then again we reach at same conclusion by making appropriate changes.

Proposition 3. *If a number of the form $a^2 + 3b^2$ is divisible by a prime of the form $p^2 + 3q^2$ then the quotient can be written in the form $c^2 + 3d^2$.*

Proof: We observe that

$$\begin{aligned}(pb - aq)(pb + aq) &= p^2b^2 + 3q^2b^2 - 3q^2b^2 - a^2q^2 \\ &= b^2(p^2 + 3q^2) - q^2(a^2 + 3b^2)\end{aligned}$$

is divisible by $p^2 + 3q^2$ and therefore, since $p^2 + 3q^2$ is prime, that either $pb - aq$ or $pb + aq$ is divisible by $p^2 + 3q^2$.
Therefore

$$\begin{aligned}(p^2 + 3q^2)(a^2 + 3b^2) - [p^2 + 3(\pm q)^2](a^2 + 3b^2) \\ = (pa \pm 3qb)^2 + 3(pb \pm aq)^2\end{aligned}$$

can be divided by $(p^2 + 3q^2)^2$ when the sign is chosen correctly and it follows that $(a^2 + 3b^2)/p^2 + 3q^2$ has the desired form.

Proposition 4. *If a number which can be written in the form* a^2+3b^2 *has an odd factor which is not of this form then the quotient has an odd factor which is not of this form.*

Proof: Let $xy = a^2 + 3b^2$ where x is odd. If y is even then by Porposition(1) it is divisible by 4 and $x(y/4) = c^2 + 3d^2$.
This process can be repeated until $y/4^k$ is odd.
Therefore $y = p_1p_2...p_n$ where each of the p's is either 4 or an odd prime.
If all of the odd primes in this factorization of y can be written in the form $c^2 + 3d^2$ then $xy = a^2 + 3b^2$ can be divided successively by each of the p's and proposition 2 imply that x can be written in the form $c^2 + 3d^2$. Therefore if x does not have this form then y must have an odd factor not of this form.

Proposition 5. *If a and b are relatively prime then every odd factor of* $a^2 + 3b^2$ *is of the form* $c^2 + 3d^2$.

Proposition 6. *If a and b are relatively prime and if* $a^2 + 3b^2$ *is cvcn thcn* $a + b\sqrt{(}-3)$ *can bc writtcn in thc form*

$$a + b\sqrt{(}-3) = (1 \pm \sqrt{(}-3))(u + v\sqrt{(}-3))$$

where the sign is appropriately chosen and where u and v are integers.

Proof: Since a^2+3b^2 is even, a and b must have the same parity, and since they are relatively prime they must both be odd.
Therefore each is of the form $4n \pm 1$ and either $a+b$ or $a-b$ must be divisible by 4.
If $a+b$ is divisible by 4 then the equation

$$\begin{aligned} 4(a^2+3b^2) &= (1^2+3.1^2)(a^2+3b^2) \\ &= (a-3b)^2+3(a+b)^2 \end{aligned}$$

is divisible by 4^2 because $a-3b=(a+b)-4b$ to put $(a^2+3b^2)/4$ is of the form u^2+3v^2.
where $u=(a-3b)/4$, $v=(a+b)/4$.
These equations can be solved for a and b in terms of u and v by noting that they are equivalent to

$$u+v\sqrt{(}-3)=(a+b\sqrt{-}3)(1+\sqrt{-}3)/4$$

which gives $(1-\sqrt{(}-3))(u+v\sqrt{(}-3))=a+b\sqrt{(}-3)$ as desired.
Similarly, if $a-b$ is divisible by 4 then

$$a+b\sqrt{(}-3)=(1+\sqrt{(}-3))(u+v\sqrt{(}-3))$$

for suitable u and v.
Note that u and v are relatively prime (otherwise a and b would not be relatively prime) and that $a^2+3b^2=4(u^2+3v^2)$.

Proposition 7. *If a and b are relatively prime and if a^2+3b^2 is divisible by the odd prime P then P can be written in the form $P=p^2+3q^2$ with p and q positive integers and $a+b\sqrt{(}-3)$ can be written in the form*
$a+b\sqrt{(}-3)=[p\pm q\sqrt{(}-3)][u\pm v\sqrt{(}-3)]$ where the sign is appropriately chosen and where u and v are integers.

Proof: The first statement follows by previous propositions. To prove the second statement, we follow the method used in Proposition 1.

Proposition 8. *Let a and b be relatively prime. Then* $a + b\sqrt{-3}$ *can be written in the form*

$$a + b\sqrt{-3} = \pm(p_1 \pm q_1\sqrt{-3})(p_2 \pm q_2\sqrt{-3})...(p_n \pm q_n\sqrt{-3})$$

where the p's and q's are positive integers and $p_i^2 + 3q_i^2$ *is either 4 or an odd prime.*

Proposition 9. *Let a and b be relatively prime. Then the factors in the above factorization of* $a + b\sqrt{-3}$ *are completely determined, except for the choice of signs as indicated, by the fact that*

$$(p_1^2 + 3q_1^2)(p_2^2 + 3q_2^2)...(p_n^2 + 3q_n^2) = a^2 + 3b^2$$

is a factorization of $a^2 \mid 3b^2$ *into odd primes and 4's. Moreover, if the factor* $p + q\sqrt{-3}$ *occurs then the factor* $pq\sqrt{-3}$ *does not, and conversely.*

Using the above proved statements, the lemma needed to complete Euler's proof of the case n = 3 of Fermat's Last Theorem can now be deduced very easily.

Lemma 1. *Let a and b be relatively prime numbers such that* $a^2 + 3b^2$ *is a Cube. Then there exist integers p and q such that*

$$a + b\sqrt{-3} = \left(p + q\sqrt{-3}\right)^3$$

Proof: Let $a^2 + 3b^2 = P_1, P_2, ...P_n$, be a factorization into 4's and odd primes. If this factorization contains exactly k factors of 4 then 2^{2k} is the largest power of 2 which divides $a^2 + 3b^2$ and, since

$a^2 + 3b^2$ is a cube, it follows that $2k$ and hence k are multiples of 3. Moreover, any odd prime P in the factorization must occur with a multiplicity which is a multiple of 3.
Thus n is divisible by 3 and the factors$P_1, P_2, ...P_n$, can be arranged in such a way that $P_{(3k+1)} = P_{(3k+2)} = P_{(3k+3)}$.
It follows that in the factorization of $a+b\sqrt{-3}$ given by proposition 8 the factors corresponding to each group of three P's are identical because the only choice is the choice of sign $p\pm\sqrt{-3}$ and both signs cannot occur.
Taking one factor from each group of three and multiplying them together then gives a number $c + d\sqrt{(}-3)$ such that

$$a + b\sqrt{-3} = \pm\big(c + d\sqrt{-3}\big)^3$$

Since

$$-\big(c + d\sqrt{-3}\big)^3 = \big(-c - d\sqrt{-3}\big)^3$$

the desired conclusion follows.

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Dinesh S Thakur. *Fermat's Last Theorem for Regular Primes.*

Socio-Economic Condition of Beedi Workers: A Case Study in Puttur Taluk

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Abstract: *Beedi rolling has a very important role for rural people especially women. This is generally done by poor households in backward areas where the workers have usually no other means of sustainable employment. It is because of the beedi many rural people have been benefited and improved their condition. To support the beedi workers the government of India has launched programmes like scholarships for their children, providing bonus to the workers, health cards, PF and gratuity. In this context, through this paper a small effort has been made to know the socio-economic condition of beedi workers in Puttur taluk. The study is conducted in Puttur taluk to know how the beedi workers are benefited by these schemes. The purpose of this paper is to create awareness among rural people and to know their socio- economic condition.*

Key Words: *Beedi Rolling, Socio-Economic Condition, Labor Welfare, Rural Poor, Rural Employment.*

Introduction

Employment is a very crucial part as per the Indian economic scenario. In India most of the people live in rural area where employment opportunities are very less. Rural women have serious problem regarding their employment opportunities. Earning livelihood is very difficult for those women who are illiterate and poor. Government of India had made several programmes and created many opportunities for the employment generation. Now rural women have several opportunities to earn their livelihood. Among them beedi rolling has its own role in empowering rural women. Beedi rolling is one of the major informal sector activities in India. The government of India estimates that there are about 4.4 million workers in this industry. The majority are home based workers who live below the poverty line (BPL). Beedi is a kind of little cigarette, made of tendu leaves (instead of paper) and tobacco.

According to conservative estimate more than 6 million persons are engaged in Beedi making process and allied work. Beedi workers are vulnerable segments of the country's labor force which has increased involvement of women and child labor in beedi rolling activities.

Objectives

1. To understand the socio economic background of beedi workers.
2. To find out the problems of beedi workers.
3. To understand how beedi rolling as an employment and income generating work for women.

Methodology

The present study is partially qualitative and partially quantitative in nature. The methodology of the study is as follows:

1. Area of the Study

The present study is geographically restricted to Puttur taluk of Dakshina Kannada district. The primary data is collected from the respondents in Puttur taluk.

2. Source of Data

The present study is based on both primary and secondary sources of data. Primary data are collected through sample method by using well designed questionnaire method. Besides questionnaire method personal interview method is also used for collecting the desired information. Secondary data is collected through various journals and magazines. The respondents are selected through simple random sampling method.

3. Data Analysis

In order to test the objectives of the study, data gathered through primary investigation is analysed with the help of simple statistical tools such as percentage and averages.

Beedi Rolling in India

The debate on the existence and continuity of beedi industry is heading towards major crisis day by day for want of suitable interpretations and interventions, favoring the major component of the beedi industry called the beedi rollers. India is one of those countries that encouraged the income generating activities at the level of villages to encourage the poor to overcome

their poverty. It is here in India that people experimented different activities capable of generating income and as a result of it several cottage industries came up. One among them is the beedi industry which has always had its ups and downs in its journey over the years. Unlike other cottage or small scale industries, the beedi industry has attracted and accommodated large number of rural aspirants who volunteered to take up one or the other activities involved in beedi rolling. It is commendable that no other industry succeeded in bringing out significant changes at the village level especially among the poor in its unique operation. Both men and women, aged and children, working and not working have taken up the beedi rolling either as a full time work or a part time.

A cursory look at the people engaged in beedi rolling helps in reading the entire activities positively as in its own way the beedi industry has helped in making their life with basic fulfillment. Their involvement in the industry and interest to continue with the same and of late today dealing with the industry in detail marks the significant changes taking place in the beedi industry. While attracting people to be a component, the beedi industry as a whole opened up variety of opportunities to the village level people. Over the years, it is noticed that beedi industry appeared to be a classified one as different categories of the people did different work in the industry. To make it specific, barring few cases here and there the rolling exercise has been carried out by women and all other activities until smokers have been dominated by men. Its close study like the present work may further suggest that the beedi industry has helped in improving the standard of life of those who have depended upon it. Its chronological study tells that early stages of beedi industry and later excluding the present condition helped the rollers in a big way in terms of their economic empowerment. In its earlier context related to other existing conditions the earning at the village level by the beedi rollers helped them in getting the average meal, dress and other basic requirements needed to live a life. Perhaps, this is one reason as to why people encouraged beedi industry at the village level. Its other chapter reveals that this is such an industry that did not expect the rollers to be completely involved within rolling and had provided with an opportunity to choose to be either a full time or a part time work. It indeed got popularity amongst those who opted for part time rolling besides their other routine work.

Hence, it became the most popular income generating work at the village level amongst the housewives. The housewives, besides their domestic work took to the beedi rolling exercise on part time basis that helped them in not only earning but also saving little money. This perspective of looking at beedi industry from its advantageous point of view encourages others to take up this work for more activities that may help in improving their life style.

Karnataka Scenario

The industry came into existence at the dawn of industrialization to supply cheap smoking device to poor labourers. The present form of beedi owes its origin to the tribal habits of rolling leaves for smoking, a practice which is popular among the Aadivasis and Tribals. The beedi industry contributes to the Government about Rs. 450 crores annually as revenue. This huge cottage industry caters to the needs of millions of people and the beedi has almost replaced the traditional hukka or water pipe smoking. The low paid workers and the unemployment strive to make the best use of their children by sending them early to this work in beedi industries. (Rogi S.R. 1998) In the beedi industry the following systems of production can be identified.

1. Factory System
2. Home – Based System

In the factory system, the process of beedi making takes place at the factory site itself under the direct supervision of the staff members appointed for this purpose like another industrial organizations. The wage payment is made piece wise and each worker is required to turn a fixed minimum quantity of Beedies in proportion to raw – materials supplied. In the home based system, the home of the workers is production site. In this system the distribution of raw – materials collection of beedies and disbursal of wages is made by the management either through a person who is employed by the company or through a commission agent, who is not a regular employee of the company but is paid a commission on the basis of production performance under his control.

The large sized companies have generally preferred to operate through the commission agents for this system entails lesser accountability and risk, and contrarily greater maneuverability and profit. (Rajkumar P.A. 2002 PP – 161) Beedi, the deemed “poor man’s cigarette” or the “poor man’s smoke” in India is made by rolling about 0.2 grams of tobacco flakes in tendu leaf.

In India, 34% of tobacco consumption is in the form of beedi. Snuff and chewing tobacco account for 35% whereas 22% of tobacco use is in the form of cigarettes. This shows that the size of the market for beedi is much bigger than the market for cigarettes. The total number of beedi smokers was estimated to be around 100 million in 1994-95, the majority of whom were adult males.

The total number of cigarette smokers was 25 million. In 1996, annual beedi consumption was estimated to be 700 billion sticks. The total number of cigarette sticks sold in 1996-97 was 102 billion. Smokers, mainly in the low-income categories, consume beedi, while cigarettes are consumed by the relatively well-to-do section of the population. The markets for beedi and cigarette therefore do not overlap significantly. Beedi primarily caters for the domestic market although it is exported in small quantities. In 1997-98, 1.1 million kg of beedi worth US$6.5 million was exported to 36 countries. About half of the total exports went to the United Arab Emirates (49%), followed by the United States (10%), Singapore (7%), Afghanistan (6%), Saudi Arabia (5%) and Panama (4%). These six countries accounted for an 82% share of exports with the remaining 30 sharing 18%. In the beedi industry, a large number of unregistered and home-based enterprises coexist with factory-based manufacturing enterprises. A complete census or a comprehensive nationwide database capturing important statistics of registered and unregistered enterprises is not available. The only available database is partial and fragmented, which makes it difficult to construct a time series on production and employment in this industry encompassing all types of enterprises.

There is an important difference in the organic composition of capital between the beedi and the cigarette industry. The manufacture of cigarette falls within the organized sector where the production process is factory-based and capital intensive. The industry is dominated by the presence of a few multinationals or big companies such as Imperial Tobacco Company of India Limited, Godfrey Philips and Vazir Sultan Tobacco Limited. The beedi industry, on the other hand, is domestically owned. The production is highly labour intensive and is critically dependent on the availability of cheap labour. However the conditions of work in the beedi industry raise serious concerns about unethical labour practices which run contrary to the spirit of the Declaration on Fundamental Principles and Rights at Work – a declaration adopted by the International Labour Conference in June 1998.

The Declaration calls on International Labour Organisation member States to 'respect and promote freedom of association and collective bargaining; the abolition of all forms of forced or compulsory labour; the effective abolition of child labour; and the elimination of all forms of discrimination in respect of employment and occupation'. Isolated case studies and media reports indicate that the beedi industry employs large number of women and children in inhospitable and exploitative conditions. Labour laws are grossly flouted. The workers living conditions are also poor. The industry therefore presents a typical case where concerted social action on the part of the government, workers, employers, civil societies and international organizations is need to promote and realize the goal of 'decent work'

Beedi Workers in Puttur Taluk

The beedi workers of Puttur Taluk are living in a miserable condition. Many of them belong to socially backward class and exploited by the beedi factories. They get Rs 200 as wage if they make 1000 beedies per day. The income which is generated by rolling beedi is not enough to meet their basic needs. Many of them living in kaccha houses and they have loan in banks. Many people facing health problems like cough, breathing problem etc. They also denied with the basic social security scheme in their working area.

The study is done on the topic socio economic condition of beedi workers in Puttur Taluk. It is done to gather information whether the beedi workers have education, whether they have identity card, whether they have specified age group, to know employment category, health problems faced by beedi workers, the kind of welfare facility, earning in the month, wages payment etc. The study was also conducted to gather information regarding total income of the household work done by workers whether the beedi workers have any assets, whether they attached it to any organisation.

According to 2011 census there are 53.068 thousand people living in Puttur Taluk. There are 9893 beedi workers working in Puttur Taluk. There are 3 beedi companies in Puttur Taluk they are:

1. Ganesh Beedi
2 Fail man Beedi
3. Bharath Beedi

Beedi leaves, tobacco powder and threads are imported from other states. The Beedi leaves are imported from Madhya Pradesh, Maharashtra. Tobacco

powders are imported from Nipani. Threads are imported from Doddabathi, Andhra.

The raw materials are given to the people by the contractors. Beedi will be collected by the people every day. 15 lakh beedis are collected by the people through contract basis and 60 lakh beedis are collected monthly. The wages of beedi workers are given by the contractor's weekly. The wages for contractors will be given on the basis of commission. Daily collected beedis are heated and it will go to label and it will be bundled and send to Mysore head office when they ask for it.

The beedi workers will get bonus yearly and it will be given on the basis of their earned wages. If the beedi workers have the pass book, if their children are going to the school, then they will get scholarship. The beedi workers will get more benefit from government. Government will provide health care facilities to the beedi workers and this card facilitates them to get any health facilities if they require.

The ban of beedi sounds everywhere now a days. If the beedi is banned the beedi workers will have a lot of troubles. The production of beedi is reduced every year.

Findings of the Study

1. Majority of the beedi rollers are illiterate.
2. Female labour force is the main source to the beedi industry.
3. Beedi rollers are not organised yet.
4. Younger generation is chief source of labour force to the beedi industry.
5. Beedi workers are giving importance towards the education of their children.
6. Beedi rollers are not satisfied with the remuneration.
7. Ill-health is the major drawback of the beedi workers.
8. The beedi work is carried as subsidiary source of income.
9. Beedi rolling work is carried with the support and co-operation of their family members.
10. Beedi rollers are having poor standard of living.

Conclusion

Modern generation is coupled with a dozen of bad habits along with their virtues. Beedi smoking is common among the middle income teenage, younger and elder generation. Therefore the demand for beedi product has been increasing over the years. Hence there is much scope for beedi industry.

It is obvious that beedi rolling process can be carried even by illiterate individual also. At present a plethora of illiterate female generation are embraced with the beedi rolling work for their income. However this work is monotonous in nature and harmful to both body and mind. Again the workers of beedi industry are not organized and united. Therefore they are working under visual circle of middle man and agency.

Therefore government should launch a number of social security measures and effective labour laws for the benefit of beedi workers.

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Analysis of Social Security Scheme: A Study in Peraje Village

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Abstract: *The social protection to the working class people plays crucial role in the time of accidents; mishappenings and at the time of old age. A country will develop when it has more productive labours. When it comes to the labour welfare and development, the social security scheme stands first. Government has launched many social security schemes but it focused only on organized sector workers in reality. From the decade, major portion of unorganized sector workers are denied by the basic social security schemes like PF, ESI, gratuity etc. Many attempts were made by the various Governments to overcome this problem. Keeping this in mind Government of India has launched JAN SURAKSHA scheme under Financial Inclusion Programme in 2015. The three social security schemes like PMSBY (accidental benefit scheme), PMJJBY (Any type of death compensation scheme) and APY (old age pension scheme) were introduced by the government in order to give social protection to the unorganized sectors of India. The study is conducted in Peraje village to know how these schemes obtained and reached to the unorganized sector workers of the village. The purpose of my research is to create awareness and to evaluate the performance of proposed social security schemes like PMSBY, PMJJBY and APY scheme in Peraje village of Madikeri Taluk.*

Key Words: *Social Security, Labour Welfare, Unorganized Sector, Financial Inclusion.*

Introduction

Social Security is becoming a distinct part of Social Policy of our country and the time has come to give serious thought to ever-increasing Social Security needs of the population. There are diversified views on extension of Social Security coverage. Some say it should be limited to only working population and to their families and while others say that the entire population should be covered under social security programmes. In this background it is proposed to examine and understand the concept and objectives of Social

Security, Social Security schemes in general and the administration of provident fund, pension schemes available in the country in particular, their administrative arrangements like coverage, implementation of the legislation, benefit delivery etc. It is also proposed to attempt to suggest the methods to strengthen the administrative arrangements available for benefit dispensation. Our study mainly deals with the PMSBY, PMJJBY and Atal Pension scheme from the administration/organizational point of view.

Objectives of the Study

1. To study how best APY, PMSBY, PMJJBY schemes have succeeded in reaching population of Peraje.
2. To understand the benefit of three schemes and to know how much expenditure the government of India has to bear uplifting these schemes
3. To understand which scheme is more obtained by the people of Peraje village and make comparison between other private insurance scheme.

Methodology

The present study is partially qualitative and partially quantitative in nature. The methodology of the study is as follows.

Area of the Study

The present study is geographically restricted to Peraje village of Madikeri Taluq. The primary data is collected from the respondents in Peraje village.

Source of Data

The present study is based on both primary and secondary sources of data. Primary data is collected through sample method by using well designed questionnaire method. Besides questionnaire method personal interview method will also be used for collecting the desired information. Secondary data is collected through various journals and magazines. The respondents shall be selected through simple random sampling method.

Data Analysis

In order to test the objectives of the study, data gathered through primary investigation shall be analyzed with help of simple statistical tools such as percentage and averages.

Social Security in India

The underlying idea behind social security measures is that there is a duty on the society to protect the working class that contributes to the welfare of the society against hazards. It protects not just the workman, but also his entire family in financial security and health care. The social security can be provided by institutional and non institutional agencies. The non-institutional agencies existed from time immemorial and they are the back bones of the present social security programmers. India is a good example of having non-institutional form of social security measures in the world. The needy and unfortunate are seen protected in joint family set up and the caste system. The hardship due to unemployment, economic difficulties, old age, widowhood etc., was taken care of by joint family system.

It had a religious backing also. An additional help from individual and institutions was provided to them through the guilds, community and Panchayats, orphanages, widow homes and charity centers available during that time. This indicates that India had its own social security systems of 1. Self-sufficient village economy; 2. Caste system; 3. Joint family system; 4. Organizations of charity. Following the development of liberalism and individualism fostered by the Western influence, these roots of Indian society were shaken and ultimately lost its significance. The society, its culture and custom were affected a great deal by the foreign impact and a new society based on class gradually emerged. Industrialization created a new class and this rising up class with its rural background and without social and material resources urgently necessitated systematic help from various social security agencies other than the traditional ones. The ideals of social security ultimately became a social responsibility largely depending on the resources and needs of the country. India is a country, where economic resources are less and needs are more. The social security enactments that we find today in India are an amalgam of the ideals and principles emerged over the years.

In the early historical times, people were living in a more secured or protected environment. As stated above, the system of the joint family, the guilds, the caste, community panchayats and religious institutions have been providing protection to individuals from the evil consequences of various contingencies. The development of modern state totally changed the social set up in India and the state assumed the role of protector of people from evils. The philosophy of welfare has resulted in legislative schemes designed to channel all economic

activity for collective good. Originally, labour law was almost a part of private law but now it has become part of public law.

From the middle of 19th Century to the end of First World War, the Indian Industrial Legislation was in the period of origin. It was through a slow and steady process that the Industrial Law took root in India. The Apprentices Act figures the first law introduced in India relating to labour. It was enacted for better enabling children to learn trades, crafts and to seek employment by which when they come to full age, they may gain a livelihood.

Famous Social Security Schemes

Pension or Employee's Provident Fund

The Employees' Provident Fund Organization, under the Ministry of Labour and Employment, ensures superannuation pension and family pension in case of death during service. Presently, only about 35 million out of a labour force of 400 million have access to formal social security in the form of Old-Age Income protection in India. Out of these 35 million, 26 million workers are members of the Employees' Provident Fund Organization, which comprises private sector workers, civil servants, military personnel, and employees of State Public Sector Undertakings (PSUs).

Health Insurance and Medical Benefit

India has a National Health Service, but this does not include free medical care for the whole population. The Employees' State Insurance (ESI) Act creates a fund to provide medical care to employees and their families, as well as cash benefits during sickness and maternity, and monthly payments in case of death or disablement for those working in factories and establishments with 10 or more employees.

The ESI (Central) Amendment Rules, 2016 – notified on December 22, 2016 – expanded coverage to include employees earning Rs 21,000 (US$313.53) or less in a month from January 1, 2017; previously, the wage limit for ESI subscribers was Rs 15,000 (US$223.95) per month. Subsequently, the Employees' State Insurance (Central) Amendment Rules, 2017 was notified on January 20, detailing new maternity benefits for women who have insurance.

Maternity Benefit

The Maternity Benefit (Amendment) Act, 2017 came into force on April 1, 2017, and increases some of the key benefits mandated under the previous Maternity Benefit Act of 1961. The amended law provides women in the organized sector with paid maternity leave of 26 weeks, up from 12 weeks, for the first two children. For the third child, the maternity leave entitled will be 12 weeks. India now has the third highest maternity leave in the world, following Canada (50 weeks) and Norway (44 weeks).

The Act also secures 12 weeks of maternity leave for mothers adopting a child below the age of three months as well as to commissioning mothers (biological mothers) who opt for surrogacy. The 12-week period in these cases will be calculated from the date the child is handed over to the adoptive or commissioning mother.

Gratuity

The Payment of Gratuity Act, 1972 directs establishments with ten or more employees to provide the payment of 15 days of additional wages for each year of service to employees who have worked at a company for five years or more.

Gratuity is provided as a lump sum payment by a company. In the event of the death or disablement of the employee, the gratuity must still be paid to the nominee or the heir of the employee.

ATAL PENSION YOJNA

The Government of India has introduced a pension scheme called the Atal Pension Yojana (APY), with effect from 1st June, 2015, pursuant to the announcement in the budget for 2015-16 on creating a universal social security system for all Indians, especially the poor, the under-privileged and the workers in the unorganised sector. APY is being administered by the Pension Fund Regulatory and Development Authority (PFRDA) under the overall administrative and institutional architecture of the National Pension System (NPS). APY is a voluntary, periodic contribution based pension system, under which the subscriber would receive the following benefits

PRADHAN MANTRI JEEVAN JYOTI BIMA YOJANA

The scheme will be a one year cover, renewable from year to year, Insurance Scheme offering life insurance cover for death due to any reason. The

scheme would be offered / administered through LIC and other Life Insurance companies willing to offer the product on similar terms with necessary approvals and tie ups with Banks for this purpose. Participating banks will be free to engage any such life insurance company for implementing the scheme for their subscribers.

PRADHAN MANTRI SURAKSHA BIMA YOJANA

The scheme will be a one year cover, renewable from year to year, Accident Insurance Scheme offering accidental death and disability cover for death or disability on account of an accident. The scheme would be offered / administered through Public Sector General Insurance Companies (PSGICs) and other General Insurance Companies willing to offer the product on similar terms with necessary approvals and tie up with Banks for this purpose. Participating banks will be free to engage any such insurance company for implementing the scheme for their subscribers.

Table 1: Profile of Peraje Village Panchayath

Particulars	Total	Male	Female
Total No of Houses	846	-	-
Populations	3823	1912	1911
Child (0-6)	384	203	181
Scheduled Caste	169	82	87
Scheduled Tribe	418	206	212
Literacy	89.24%	93.45%	85.09%
Total Workers	1878	1165	713
Main Workers	1812	1293	0
Marginal Workers	66	26	40

Source: Peraje Panchayath

Peraje is a large village located at Madikeri Taluk of Kodagu District, Karnataka with total 846 families residing. The Peraje Village has a population of 3823 of which 1912 are males and 1911 are females as per census 2011.

The number of children with age 0-6 is 384 which make up 10.04% of total population of the village. Average sex ratio is 999 which is higher than Karnataka state average of 973.Child sex ratio of Peraje is 892, which is lower than Karnataka's average of 948.

Peraje village has higher literacy rate compared to Karnataka. According to 2011, literacy rate of Peraje village is 89.24% compared to 75.36% of Karnataka.In Peraje male literacy stands at 93.45% while female literacy rate is 85.09%.

As per constitution of India and Panchayath Raaj Act, Peraje village is administered by Sarpanch who is elected representative of village.

Caste Factor

Scheduled Tribe (ST) constitutes 10.93% while Scheduled Caste (SC) is 4.42% of total population in Peraje village.

Work Profile

In Peraje village, out of total population, 1878 are engaged in work activities. Among them 96.49% of workers described their work as Full time (Employment or Earning more than 6 months) while 3.51% are involved in Marginal activity providing livelihood for less than 6 months including 29 cultivators (owners or co-owners) and 5 Agricultural labours.

Table 2: Performance of APY, PMSBY and PMJJBY Scheme in National Level

Serial Number	Schemes	Total Enrollment	Total Claims Received	Total Claims Disbursed
1.	APY	62 lakh	-	-
2.	PMSBY	13.5107 crore as on 23.04.2018	22294	16644
3.	PMJJBY	5.3382 crore as on 23.04.2018	100,881	92089

Table 3: Performance of APY, PMSBY and PMJJBY Schemes in Karnataka

State	PMSBY	PMJJBY	Total
Karnataka	6105991	2755236	8861227

Source: Finance Department of India

Table 4: Performance of APY, PMSBY and PMJJBY Schemes in Peraje Village

Serial Number	Schemes	Total Enrolment
1.	APY	46
2.	PMSBY	1845
3.	PMJJBY	1312

Source: **Grameena Bank Peraje, Kodagu**

The Three Mass Universal Social Security Schemes introduced by the Government of India in the year 2015 specially targeting unorganized sector workers in order to give social protection from probable mishap. After three years the government could not achieve its target. The performance of PMSBY and PMJJBY Scheme is appreciable in national level. The performance of APY is not upto the mark.

The study was conducted in Peraje village to know the performance and how far these schemes succeeded in reaching the people. Total 1845 and 1312 enrollment held under PMSBY and PMJJBY Scheme respectively. The performance APY scheme is noticeable in Peraje Village.

Major Findings

1. Major unorganized respondents are aware of the Social Security Scheme introduced by the government.
2. LIC India scheme more popular in Peraje village.

3. Respondents get more information from local political leaders.
4. Total enrollment under PMSBY and PMJJBY is more
5. Enrollment under APY scheme is low because of high premium amount
6. Respondents are aware of the benefits and amenities provided under these three Schemes.
7. Respondents get sufficient information.
8. Respondents strongly recommended over setting up of information centre and appointment of agents at Panchayath level.
9. Respondents know the premium amount of Schemes than the name of the Scheme.

Conclusion

Government passed many Schemes in order to give social protection to the organized sector workers like PF, ESI and Gratuity etc. It is a milestone in the history of Labour Welfare. In India unorganized sector workers have been deprived of the basic Social Security Schemes for the last six decades. Many governments passed many schemes but could not reach the real beneficiaries. Keeping this in mind the NDA government passed Universal Social Security Schemes specially targeting unorganized workers of India under Financial Inclusion Program namely Jan Suraksha Scheme. The Scheme is performing well. It covered all sections of the society in providing basic social protection to unorganized workers of India. Still there are many setbacks in the schemes. Government must specially focus those areas in order to have effective implementation of the schemes.

It can be concluded that the organized efforts are necessary for the welfare of labour class. They are most vulnerable and deprived section of the society in need of protection, security and assistance. A lot of weaknesses have been found relating the proper implementation, inadequacy of benefits, long procedure of assigning benefits etc. Obviously such factors create great hurdles in the proper execution of social security and are also responsible for the limited utilization of the Social Security Legislations which hit the basic aim and objective of the social security. The social security system needs to be effective and constructive and should have of more and more coverage areas. The government should get the confidence of the working class to protect them from uncertain contingencies so that they can happily contribute towards Social Security Scheme.

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Job Satisfaction of Employees with Special Reference to CAMPCO Chocolate Factory, Darbe, Puttur

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Abstract: *Job satisfaction is the end feeling of a person after performing a task. To the extent that a person's job fulfils his casual needs and in consistency with expectations and values, the job will be satisfying. The feeling would be positive depending upon whether need is satisfied or not. Job satisfaction and occupational success are major factors in personal satisfaction, self-respect, self-esteem, and self-development. To the worker, job satisfaction brings a pleasurable emotional state that can often leads to a positive work attitude. A satisfied worker is more likely to be creative, flexible, innovative and loyal. For the organization, job satisfaction of its workers means a work force that is motivated and committed to high quality performance. Hence this paper examines the job satisfaction levels of employees provided by the factory and it examines the ways of promoting the job satisfaction of employees. The population for the study consists of employees of CAMPCO Chocolate Factory, Puttur. 50 respondents were taken for the study. The technique used for the study is simple random sampling technique. Primary and Secondary data available also made use for the study purpose. The results show that there is significant amount of job satisfaction among the employees of CAMPCO.*

Key Words: *Job Satisfaction, Occupational Success, Work Attitude, Performance.*

Introduction

People are the most important asset of any Company. The perception and satisfaction level of workforce in an organization would determine the future course and success of the company. Employee satisfaction can be defined as an individual's general attitude towards his or her job. Research shows that satisfied, motivated employees will create higher customer satisfaction and in turn positively influence organizational performance noticing this trend, many organizations are investing in measuring and quantifying employee opinions and attitudes by incorporating employee satisfaction surveys into their existing HR organizational processes.

Employees are more satisfied when they have challenging opportunities at work. This includes chances to participate in interesting projects, jobs with a satisfying degree of challenge and opportunities for increased responsibility. High employee satisfaction levels can reduce turnover. Employee retention and turnover are the most objective measures of employee satisfaction / dissatisfaction in organizations.

Determinants of Job Satisfaction

According to Abrahan A. Korman, there are two types of variables which determine the job satisfaction of an individual. These are:

1. Organizational variables; and
2. Personal Variables.

Organisational Variables

1. Occupational Level

   The higher the level of the job, the greater is the satisfaction of the individual. This is because higher level jobs carry greater prestige and self control.

2. Job Content

   Greater the variation in job content and the less repetitiveness with which the tasks must be performed, the greater is the satisfaction of the individual involved.

3. Considerate Leadership

   People like to be treated with consideration. Hence considerate leadership results in higher job satisfaction than inconsiderate leadership.

4. Pay and Promotional Opportunities

   All other things being equal these two variables are positively related to job satisfaction.

5. Interaction in the Work Group

   Interaction is most satisfying when -
   It results in the cognition that other person's attitudes are similar to one's own. Since this permits the ready calculability of the others behaviour and constitutes a validation of one's self;
   It results in being accepted by others; and
   It facilitates the achievements of goals.

Personal Variables

For some people, it appears most jobs will be dissatisfying irrespective of the organizational condition involved, whereas for others, most jobs will be satisfying. Personal variables like age, educational level, sex, etc. are responsible for this difference.

1. Age

Most of the evidences on the relation between age and job satisfaction, holding such factors as occupational level constant, seems to indicate that there is generally a positive relationship between the two variables up to the pre-retirement years and then there is a sharp decrease in satisfaction. An individual aspires for better and more prestigious jobs in later years of his life. Finding his channels for advancement blocked, his satisfaction declines.

2. Educational Level

With occupational level held constant, there is a negative relationship between the educational level and job satisfaction. The higher the education, the higher the reference group which the individual looks up for guidance to evaluate his job rewards.

3. Role Perception

Different individuals hold different perceptions about their role, i.e. the kind of activities and behaviours they should engage in, to perform their job successfully. Job satisfaction is determined by this factor also. The more accurate the role perception of an individual, the greater his satisfaction.

4. Sex

There is as yet no consistent evidence as to whether women are more satisfied with their jobs than men, holding such factors as job and occupational level constant. One might predict this to be the case, considering the generally low occupational aspiration of women. Some other determiners of job satisfaction are as follows:

General Working Conditions.
Grievance handling procedure.
Fair evaluation of work done.
Job security.
Company prestige.
Working hours etc.

Review of Literature

Abraham Maslow (1954) suggested that human need form a five-level hierarchy ranging from physiological needs, safety, belongingness and love, self esteem to self-actualization. Based on Maslow's theory, job satisfaction has been approached by some researchers from the perspective of need fulfillment (Kuhlen, 1963; Worf, 1970; Conrad et al., 1985).

According to the study conducted by Friedlander and Margulies (1969), it was discovered that management and friendly staff relationships contribute to the level of job satisfaction. However, this result contradicts with view of Herzberg (1966) who supported the view that supervision is irrelevant to the level of job satisfaction.

CAMPCO Chocolate Factory, Puttur

"Central Aracnut and Cocoa Marketing and Processing Co-operative Limited" or popularly known as CAMPCO started on 11th July 1973 at Mangalore, under section 7 of Karnataka Co-operative Societies Act. It had established itself as a multi co-operative, a joint venture of the states of Karnataka and Kerala. The organization is mainly into procurement, marketing, selling and processing of areca nut and cocoa. The company also provides guidance for farmers for growing aracnut and cocoa. The company has set up a chocolate manufacturing plant in 1986 at Kemminje village in Puttur Taluk in South Canara District, Karnataka. The Company produces chocolates and other products of cocoa both under its own brand and also for Nestle. It started to produce cocoa based products in January 1987 in order to procure reasonable price for locally grown cocoa and to increase the local competition for the cocoa based products.

Features of the Chocolate Factory

1. The factory is the largest in South East Asia.
2. It is one of the most modern factories in the world. The factory is equipped with the most modern machinery imported from European countries.
3. The well experienced architects and consultants designed the factory.
4. The Campo Ltd. earns Foreign Exchange.
5. Quality of products manufactured is of International Standard.

6. The construction of the factory has been completed in a record time. The factory is situated in an industrially backward rural area in the midst of cocoa cultivation area.

Objectives of the Study

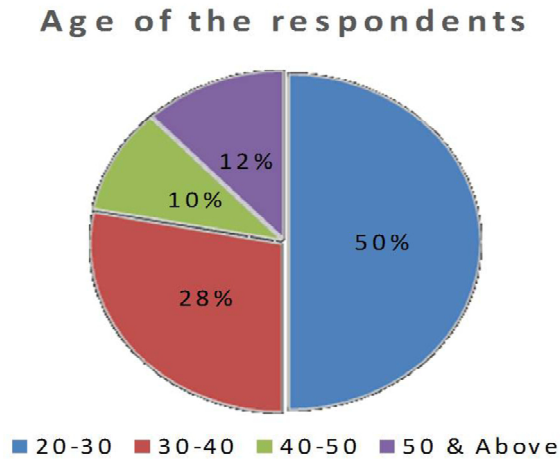
1. To Study about socio demographic profile of the employees
2. To know about work environment of the employees
3. To study the emotional status of the employees
4. To examine the factor that influences the job role satisfaction of the employees
5. To analyse the personal growth and development of employees.
6. To study the level of job satisfaction of the employees in CAMPCO Chocolate Factory Puttur.

Method of Data Collection

The researcher had taken 50 respondents from the different departments of the CAMPCO Chocolate Factory Company. The researcher selected the sample in criteria of easily reachable, with equal chance to respondents. "Simple Random Sampling" for data collection.

Results and Discussions

Fig 1: Age of the Respondents



The above figure shows that Majority (50%) of the respondents come under the age group of 20-30 years, 28% of respondents are in the age group of 30-40 years, and 10% of respondents are in the age group of 40-50 years, and 12% of the respondents are above 50 years of age.

This indicates that majority of the respondents were young employees and were recruited for more creative and fast work process. They could really work for their career, individual, and organizational growth and development.

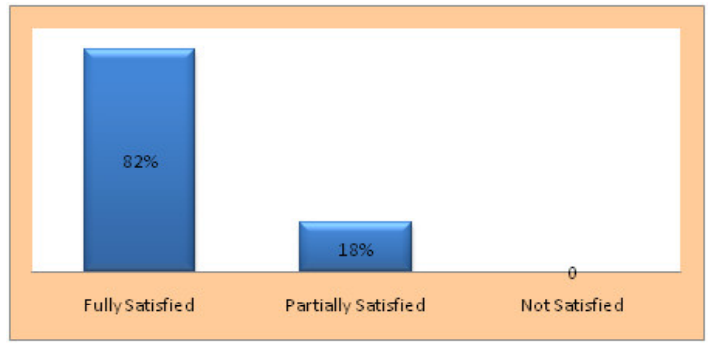
Table1: Company's Working Culture

Variables	Frequency	Percentage
Fully Satisfied	31	62
Partially Satisfied	18	36
Not Satisfied	1	2
TOTAL	**50**	**100**

The above Table shows that 31(62%) respondents are fully satisfied at their company's working culture, and 18(36%) respondents are partially satisfied, and 1(2%) respondents are not satisfied with the company's working culture.

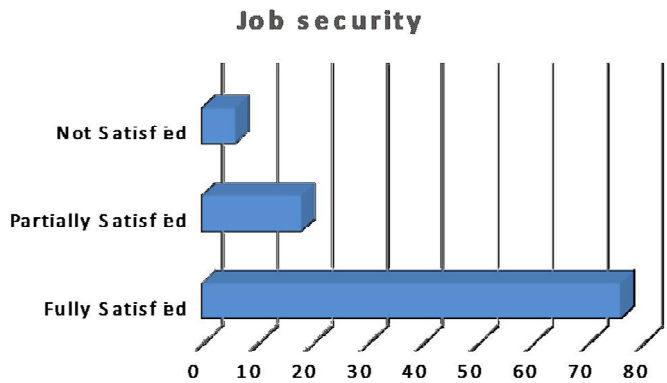
It clearly indicates that majority of the respondents were fully satisfied with the working culture of the company, CAMPCO chocolate Factory Limited. Further information revealed that company provided support and guidance to each worker and also provides trainings for their work.

Fig 2: Satisfaction of Work Responsibility



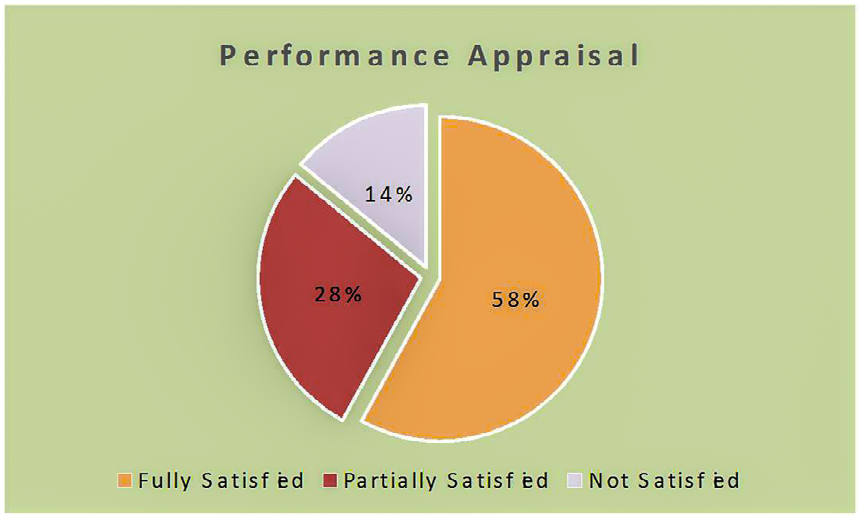
The above figure shows the satisfaction of their work responsibility. A Majority of employees 41(82% of the respondents) stated that they are fully satisfied of their work responsibility, 9(18%) of the respondents are not fully satisfied of their work responsibility. The opinion of the respondents were only fully satisfied or partially and no one stated that not satisfied. Majority of the respondents were fully satisfied with their work responsibility. Because of the Company Selection and Training programme, it made them more efficient and effective responsible workers and created interest in taking responsibility of their job.

Fig 3: Job Security



A Majority (76%) of the respondents were fully satisfied with their job security, 18% of the respondents are partially satisfied with their job security, 6% of the respondents stated that they are not satisfied with the job security.

Fig 4: Performance Appraisal System

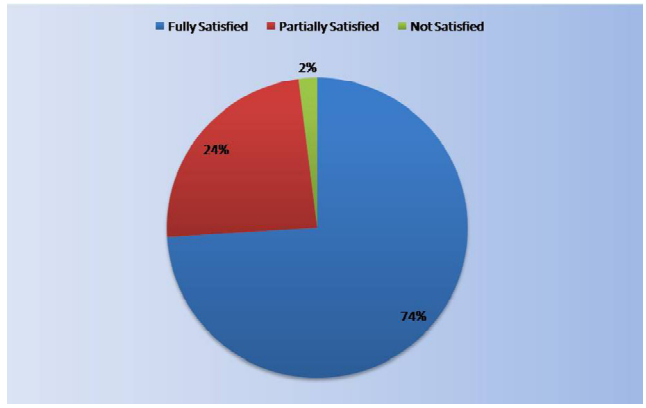


This diagram presents the satisfaction level of the respondents in the Performance Appraisal System of the company, CAMPCO Chocolate Factory Limited.

A Majority (58%) of the respondents were fully satisfied, 28% of the respondents said they were partially satisfied, 14% of the respondents were not satisfied with their company's Performance Appraisal System.

It clearly indicates that the majority of the respondents were fully satisfied with their company's present performance appraisal system. It is because of this, employees were involved in work fairly and correctly.

Fig 5: Company Policy



The above Figure reveals that 74% of the respondents were fully satisfied with their Company's Policy and Administration, 24% partially satisfied and other 2% of the respondents were dissatisfied with their Company's Policy and Administration.

From the above data, it can be interpreted that majority of the employees were fully satisfied with their Company's Policy and Administration. These are increasing the employee morale towards the growth and development of the company.

Suggestions

1. All employees need to be given good pay/salary as far as possible.
2. Since majority of the employees have less than five years of experience, company should focus on employee trainings and guidance from the senior employees.
3. The organization has to provide counselling facilities to its employees because, employees are considered as an asset of an organization. This will improve the psychological attitude of the employees towards their work and can build good interpersonal relationship with co-workers, supervisors and family members.
4. Adequate and healthy working condition to be provided to all the employees.
5. Adequate welfare facilities need to be provided to all employees.

Conclusion

In the modern scenario, Job satisfaction is very important for every company in order to get profit as well as high status in the society. For management, a satisfied work force transforms into higher productivity due to fewer disruptions caused by absenteeism or good employees quitting, as well as into lower medical and life insurance costs. Additionally, there are benefits for society in general. So the goal of high job satisfaction for employees can be defended in terms of both money and social responsibility. Managers should be concerned with the level of job satisfaction in their organizations. "A happy worker is a productive worker". It gives clear evidence that dissatisfied employees skip work more often and satisfied worker likely to work longer with the organization.

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A Study on Consumer Satisfaction on Maggi Noodles

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Abstract: *Consumer satisfaction is a term frequently used in marketing. It is a measure of how products and services supplied by a company to meet or to surpass its customer expectation. Customer satisfaction is defined as the number of customers or percentage of total customers, who's reported experience with a firm its products, or its services exceeds specified satisfaction goals. The Marketing Accountability Standards Board (MASB) endorses the definitions, purposes, and constructs of classes of measures that appear in marketing metrics as part of its ongoing common language in marketing project in a survey of nearly 200 senior marketing managers, 71 percent responded that they found a customer satisfaction metric very useful in managing and monitoring their businesses. It is seen as a key performance indicator within business and is often a part of balanced scorecard. In a competitive marketplace where business competes for customers, customer satisfaction is seen as a key differentiator and increasingly has become a key element of business strategy.*

Key Words: *Consumer Satisfaction, Business Strategy, Marketing, Accountability.*

Introduction

Maggi is a Nestle Brand of instant Soups, Stocks, Bouillon Cubes, Ketchups Sauces and Instant noodles. The company came into an existence in 1872 in Switzerland. Very soon it became a pioneer in a industrial food production, aiming at improving the nutritional intake of worker families. It was the first to bring protein-rich legume meal to the market, which was followed by ready-made soup based on legume meal in 1886. In 1897, Later Julius Michael Johannes Maggi founded the company Maggi Gmbh in the German town of Singen where it is still established today.

Maggi was launched in India in the early 1980s. Carlo M. Donati, the present Chairman and Managing Director of Nestle India Ltd, brought the instant noodle brand to India during his short stint here in the early eighties. Needless to say at that time, there was no direct competition. But when we

look into the deep, we see there was a competition from the ready-to-eat snack segment which includes snacks like samosas, biscuits, peanuts etc. Moreover homemade snacks like pakoras or sandwiches also equally treated as competition to Maggi products. The both competitors had certain drawbacks in comparisons such as samosas are usually bought out, and outside food is generally considered unhygienic and unhealthy. The other competitor, homemade snacks overcame both these problems but had the disadvantages of extended preparation time at home. Maggi was positioned as the only hygienic homemade snack!, despite this Nestle faced difficulties with their sales after the initial phase; because the company aimed to market its product to a wrong group. The company positioned Maggi as a convenient food product aimed at the target group of working men. Maggi was positioned as 2-minute noodles with a punch line that said "Fast to cook! Good to eat!", and this gave the implied understanding to the consumer that it was a between meals snack. The company could have easily positioned the product as a meal, either lunch or dinner. But it chose not to do so, because the Indian consumer mindset did not accept anything other than rice or roti as a meal.

Objectives

The current study on customer satisfaction of Maggi noodles based on the following objectives

1. To know the sales turnover of the company
2. To know the profit of the company
3. To know the customer satisfaction of the product
4. To know the profit history of the company
5. To know the various products of the company

Limitations of the Study

The study on customer satisfaction on Maggi noodles based on the following limitations

1. This study is done by intervewing limited no of consumers. Therefore it may not reflect the authentic information.
2. The sample size is 25 consumers that may not give the true results.
3. The information collected is restricted to the number of consumers.

Methodology

The research will be carried out in the form of a survey. This will include primary research in addition to secondary research as stated below. The survey research method will be descriptive research design. Each respondent will be interviewed through a questionnaire. The sample will be selected by a simple random sampling method.

Information areas

The survey will address the following information area:

The objective as spelt out can be elaborated into specific information areas to be studied.

- How do consumers perceive maggi as a stable brand, their perception of noodle and how do they associate themselves with maggi?
- Are the consumers aware of maggi brand or they associate noodles with some other brand?
- Which product from the entire basket of maggi products do the consumers consider as the best selling product for maggi and to which the consumers frequently buy?
- Are the consumers willing to accept maggi brand extensions to some other products like chocolates, juices, chips etc.?

Demography and Psychography of Consumers

Demography

1. Age and sex: Maggi products are consumed by people of different age groups. They are consumed by children, teenagers, adults as well as old age people. They are consumed by both genders male and female.
2. Income: Maggi products are available at reasonable prices. So they are consumed by the lower, middle as well as the higher class people.
3. Religion and Nationality: Maggi products are famous and are consumed by people of all religions and nationality.

Psychograph

1. Attitude: Consumers of Maggi have a positive attitude towards the product which makes it the leader in the market. Maggi dominates the market.
2. Lifestyle: Lifestyle determines the way of living of the people. It describes how a consumer leads his life. Maggi products are consumed by all.

Findings on Study

Data Analysis and Interpretation of Data

1. Consumer Satisfaction About the Product

Table 1: Product Satisfaction

Sl. No	Particulars	No of respondents	Percentage
1.	Yes	21	84
2.	No	4	16
	Total	**25**	**100**

Source : Survey analysis

1. 84 percent of the people including rural and urban area are satisfied with the product. Only 16 percent are not satisfied up to their expectation.
2. The Product has earned goodwill in the market.

Table 2: Good Name in the Market

Sl. No	Particulars	No of respondents	Percentage
1.	Yes	24	96
2.	No	1	4
Total	**25**	**100**	

Source : Survey analysis

1. Only 4 percent of people say that maggi has not earned good name in the consumer market. But 96 percent has expressed that maggi has really earned 'Good Name' in the market.
2. Earnings spent by the respondents for the product Maggi Noodles.

Table 3: Income spent by the respondent for consumption of maggi noodles.

Sl. No	Particulars	No of respondents	Percentage
1	Below Rs 500	19	76
2	Rs 1500 to Rs 1000	5	0
3	Rs 1000 to Rs 1500	1	4
	Total	**25**	**100**

76% of people spent below Rs 500 of their income for consuming Maggi Noodles .5% of people spent between Rs 500 and Rs 1000 of their income and only 1% of people spent between Rs 1000 and Rs 1500 of their income for consuming Maggi Noodles.

Table 4: Source of Information

Sl. No	Particulars	Respondents	Percentage
1	Advertisement	13	52
2	Friends	4	16
3	Family members	6	24
4	Others	2	8
	Total	25	100

52% of the respondents have come to know about Maggi Noodles through Advertisements. 16% of the customers have come to know about Maggi Noodles from their friends, 24% of the respondents are come to know about maggi noodles through their family members and 8% of the respondents have come to know about others.

Conclusion

The food processing business in India is at a nascent stage. Currently, only about 10% of the output is processed and consumed in packaged form thus highlighting huge potential for expansion and growth. Traditionally Indians believe in consuming fresh stuff rather than packaged or frozen, but the trend is changing now and slowly food processing business is growing.

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Faceopedia - High Speed Face Recognition Using DCT RBF Neural Network

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Abstract: *The paper titled "FACEOPEDIA"- A High speed face recognition system using DCT RBF Neural Network is designed to identify the face. There are number of algorithm proposed to do the task of face recognition. The face recognition is one of the most trending and new research area where several research activities are taking place. The face is composed of a complex structure; it varies from person to person. There are several applications regarding the face recognition, they are: attendance system, door opening system, authentication system etc. In this project we are using Discrete Cosine Transform (DCT) algorithm along with the Radial Basis Function Neural network. The neural network is needed to identify the complex facial architecture present in the face. The DCT will reduce the dimension and also extracts the essential features of the face.*

Key Words: *Faceopedia, Discrete Cosine Transform, Neural Network, Facial Architecture, Radial Basis Function.*

Introduction

Face recognition is a biometric method of identifying an individual by comparing live capture or digital image data with the stored record for that person. Face recognition is a system using which several real world applications are built to ease the daily activities. Numerous approaches have been proposed for face recognition and considerable successes have been reported. However, it is still a difficult task for a machine to recognize human faces accurately in real-time, especially under variable circumstances such as variations in illumination, pose, facial expression, makeup, etc. The similarity of human faces and the unpredictable variations are the greatest obstacles in face recognition.

Face is a complex multidimensional structure that needs good computing techniques for recognition. The face is our primary focus of attention in

social life playing a main role in the identification of individual. We can recognize a number of faces learned throughout our lifespan and identify them at a glance even after years. There may be variations in faces due to aging and distractions like glass, beard or change of hairstyles.

Face recognition is the ability to recognize person by their facial characteristics. Holistic face recognition has attracted more attention since the well-known statistical method, the principal component analysis (PCA). When the face database becomes larger, the time for training and the memory requirement will significantly increase. Moreover, the system based on the PCA should be retrained when new classes are added. As a consequence, it is impractical to apply the PCA in systems with a large database. The discrete cosine transform (DCT) has been employed in face recognition.

Existing System

The face recognition uses the different algorithms to process the different parts that is present in the face. One such algorithm is PCA; it is not efficient method for recognizing the face. The system based on the PCA should be retrained when new classes are added. As a consequence, it is impractical to apply the PCA in systems with a large database. When the face database becomes larger, the time for training and the memory requirement will significantly increase.

Proposed System

The face recognition system is one of the most important areas in modern days. In many organizations, using the face recognition much operation is generally possible. In the proposed system, the DCT algorithm along with the RBF neural network will accomplish the task of identifying the human face more efficiently. The DCT algorithm is mainly used for converting the original image into the reduced dimension and also it will extract the essential features from the human face. The neural network will be used to identify the complex human face architecture. The human face is composed of so many hidden architectures. To identify the human face which is composed of complex architecture is very difficult for a normal computer. The neural network will ease the task of identifying the complex architecture of the human face.

Image Processing System

Image Processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to

extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing System includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers. The goal of this manipulation can be divided into three categories:

1. Image Processing image in'! Image out
2. Image Analysis image in'! Measusrement out
3. Image Understanding image in'! High-level description out

We will focus on the fundamental concepts of image processing. Space does not permit us to make more than a few introductory remarks about image analysis. Image understanding requires an approach that differs fundamentally from the theme of this book. Further, we will restrict ourselves to two dimensional (2D) Image Processing although most of the concepts and techniques that are to be described can be extended easily to three or more dimensions

Purpose of Image Processing

1. **Visualization -** Observe the objects that are not visible.
2. **Image sharpening and restoration -** To create a better image.
3. **Image retrieval -** Seek for the image of interest.
4. **Measurement of pattern -** Measures various objects in an image.
5. **Image Recognition -** Distinguish the objects in an image.

Types of Image Processing

The two types of methods used for Image Processing are Analog and Digital Image Processing.

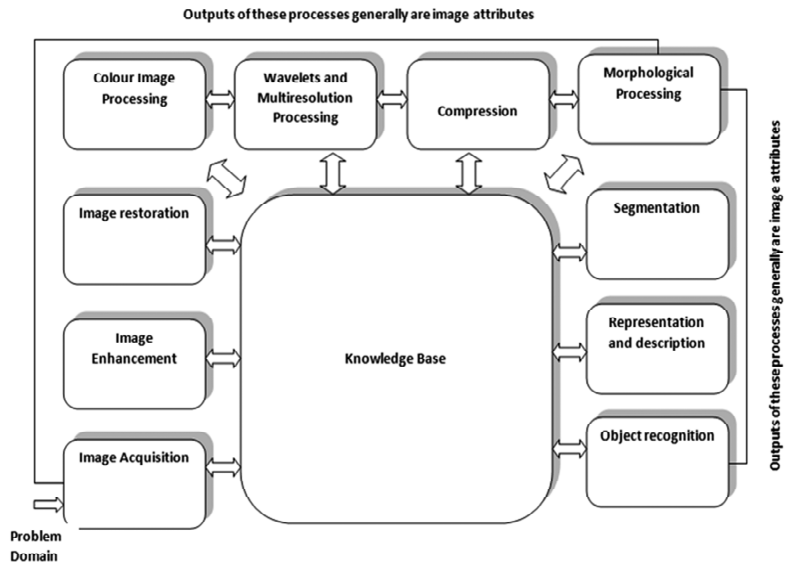
Analog or Visual Techniques of Image Processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The Image Processing

is not just confined to the area that has to be studied but on the knowledge of the analyst. Association is another important tool in Image Processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to Image Processing.

Digital Processing Techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all the types of data have to undergo while using digital technique are pre-processing, enhancement and display, information extraction.

Fundamental Steps in Image Processing:

Fig 1: Digital Image Processing



Hardware and Software Interfaces

The SRS should specify the logical characteristics of each interface between the hardware components and software product.

The hardware interfaces are:

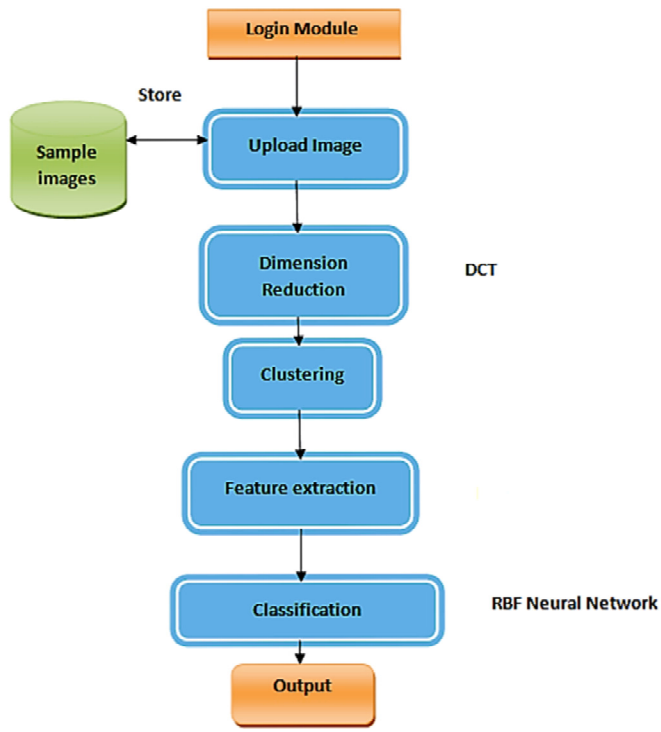
Processor	Intel Dual Core or above
RAM	3GB or above
Hard disk	20GB Hard Disk or above

The software interfaces are:

Operating System	Windows XP or above
Developing Tool	Matlab

Architecture of the System

Fig 2: Architecture of Faceopedia



The High Speed Face Recognition System is based on 5 Modules:

1. Upload image module
2. Dimensionality reduction module
3. Clustering module
4. Feature extraction module
5. Classification module

1. Upload Image Module

The Upload Image Module will allow the user to upload the JPEG image to the system.

2. Dimensionality Reduction Module

Once the JPEG image is uploaded into the system, the dimension of the image is reduced by using the DCT. The DCT has been widely applied to solve numerous problems among the digital signal processing community. For an MXN image, we have an MXN DCT coefficient matrix covering all the spatial frequency components of the image.

Discrete Cosine Transform

The mathematical theory of linear transforms plays a very important role in the Signal and Image Processing area. They generate a set of coefficients from which it is possible to restore the original samples of the signal. In many situations, a mathematical operation – generally known as a transform – is applied to a signal that is being processed, converting it to the frequency domain. With the signal in the frequency domain, it is processed and, finally, converted back to the original domain. A mathematical transform has an important property: when applied to a signal, i.e., they have the ability to generate decorrelated coefficients, concentrating most of the signal's energy in a reduced number of coefficients.

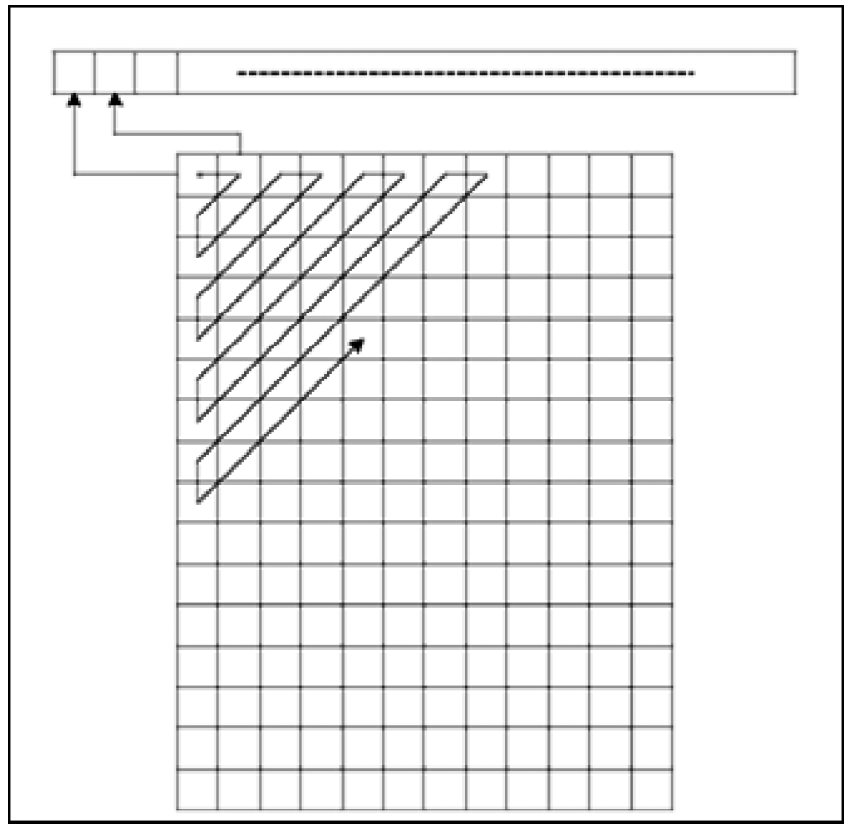
The Discrete Cosine Transform (DCT) is an invertible linear transform that can express a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. The original signal is converted to the frequency domain by applying the direct DCT transform and it is possible to convert back the transformed signal to the original domain by applying the inverse DCT transform. After the original signal has been transformed, its DCT coefficients reflect the importance of the frequencies

that are present in it. The very first coefficient refers to the signal's lowest frequency, known as the DC-coefficient, and usually carries the majority of the relevant (the most representative) information from the original signal. The last coefficient refers to the signal's higher frequencies. These higher frequencies generally represent more detailed or fine information of signal and probably have been caused by noise. The rest of the coefficients (those between the first and the last coefficients) carry different information levels to the original signal.

In the Image Processing field, it is interesting to use a two-dimensional DCT (2D-DCT), because images are intrinsically two-dimensional elements. The standard JPEG, for example, establishes the use a 2D-DCT at the decorrelation step.

In the JPEG image compression standard, original images are initially partitioned into rectangular non overlapping blocks (8X8 blocks) and then the DCT is performed independently on the subimage blocks. In our proposed system, we simply apply the DCT on the entire face image. If the DCT is only applied to the subimage independently, some relationship information between subimages cannot be obtained. However, we can obtain all frequency components of a face image by applying the DCT on the entire face image. In addition, some low-frequency components are only related to the illumination variations which can be discarded. For an image, we have a DCT coefficient matrix covering all the spatial frequency components of the image. The DCT coefficients with large magnitude are mainly located in the upper-left corner of the DCT matrix. We scan the DCT coefficient matrix in a zig-zag manner starting from the upper-left corner and subsequently convert it to a one-dimensional (1-D) vector.

Fig 3: Scheme of Scanning Two-dimensional (2-D) DCT Coefficients to a 1-D Vector



The discrete cosine transform (DCT) is closely related to the discrete Fourier transform. It is a separable linear transformation; that is, the two-dimensional transform is equivalent to a one-dimensional DCT performed along a single dimension followed by a one-dimensional DCT in the other dimension. The definition of the two-dimensional DCT for an input image A and output image B is

$$B_{pq} = \alpha_p \alpha_q \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} A_{mn} cos \frac{\pi(2m+1)p}{2M} cos \frac{\pi(2n+1)q}{2N},$$

$$\begin{cases} 0 \le p \le M-1 \\ 0 \le q \le N-1 \end{cases}$$

where

$$\alpha_{p=} \begin{cases} \frac{1}{\sqrt{M}}, & p = 0 \\ \sqrt{\frac{2}{M}}, & 1 \le p \le M-1 \end{cases} \quad \textbf{and} \quad \alpha_{q=} \begin{cases} \frac{1}{\sqrt{N}}, & q = 0 \\ \sqrt{\frac{2}{N}}, & 1 \le q \le N-1 \end{cases}$$

M and N are the row and column size of A, respectively. If you apply the DCT to real data, the result is also real. The DCT tends to concentrate information, making it useful for image compression applications.

3. Clustering Module

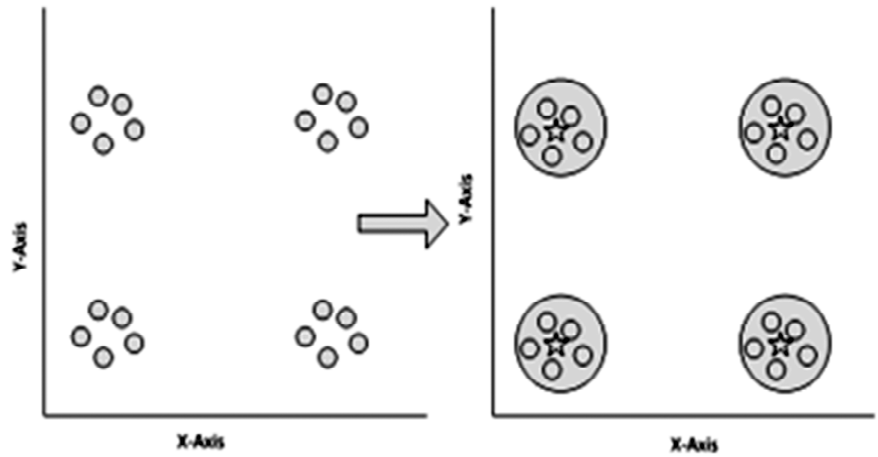
Clustering aims at storing similar or close objects into similar groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise. Figure illustrates to identify four clusters and its centres into which the input data is divided. Two well-known methods of clustering are

3.1 Partitioned clustering

3.2 Hierarchical clustering

In Partition clustering, algorithms find all the clusters simultaneously as a partition of the data and do not impose any sort of hierarchy. In many practical scenarios, there is an inherent hierarchy. The clusters have sub-classes within them, and these subclasses might have their own subclasses. Such classifications are hierarchical and they can be partitioned properly by hierarchical clustering. In partition clustering, the dataset is divided into clusters, such that each cluster has at least one data point and each data point has one cluster.

Fig 3: Clustering of Data



4. Feature Extraction Module

It is used to find a linear projection of the original vectors from a high-dimensional space to an optimal low-dimensional subspace in which the ratio of the between class scatter and the within-class scatter is maximized. After making cluster, the image is passed through high pass filters, wherein image facial parameters can be extracted effectively.

5. Classification Module

Neural Network Based Approaches

Artificial Neural Network (ANN) is a powerful tool for pattern recognition problems. The use of neural networks (NN) in faces has addressed several problems: gender classification, face recognition and classification of facial expressions. One of the earliest demonstrations of NN for face recalls application which was reported in Kohonen's associative map. Using a small set of face images, accurate recall was reported even when input image is

very noisy or when portions of the images are missing. In face recognition applications, the RBF neural networks are regarded as a mapping from the feature hyperspace to the classes. Therefore, the number of inputs of RBF neural networks is determined by the dimension of input vectors. The number of outputs is equal to the class number. The hidden neurons are very crucial to the RBF neural networks, which represent the subset of the input data. An artificial neural network is a non-linear and adaptive mathematical module inspired by the working of a human brain. It consists of simple neuron elements operating in parallel and communicating with each other through weighted interconnections.

Model of Neuron

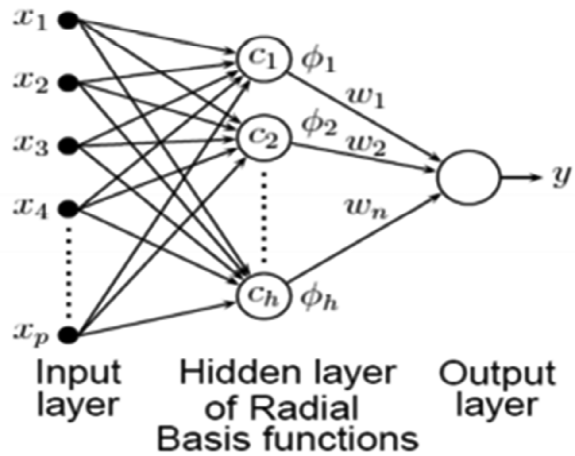
A neuron is an information-processing unit that is fundamental to the operation of a neural network. In this case of artificial neural networks, the strength of the connection between an input and a neuron is defined as the value of the weight. Negative weight values correspond to inhibitory connections, while positive values correspond to excitatory connections. The adder sums up all the inputs modified by their respective weights. Finally, a transfer function controls the amplitude of the output of the neuron. An acceptable range of output is usually between 0 and 1, or -1 and 1 depending on the transfer function selected. Figure 4 shows a typical model of an artificial neuron.

Radial Basis Function Networks (RBFN)

RBNF consists of 3 layers an 1) input layer, 2) a hidden layer, and 3) an output layer.

The hidden units provide a set of functions that constitute an arbitrary basis for the input patterns. Hidden units are known as radial centres and represented by the vectors c_1; c_2; _ _ _ ; c_h transformation from input space to hidden unit space is nonlinear whereas transformation from hidden unit space to output space is linear dimension of each centre for a p input network is px_1

Fig 4: Typical Model of an Artificial Neuron



1. Input Layer

There is one neuron in the input layer for each predictor variable. In the case of categorical variables, N-1 neurons are used where N is the number of categories. The input neurons (or processing before the input layer) standardizes the range of the values by subtracting the median and dividing by the inter quartile range. The input neurons then feed the values to each of the neurons in the hidden layer.

2. Hidden Layer

This layer has a variable number of neurons (the optimal number is determined by the training process). Each neuron consists of a radial basis function centred on a point with as many dimensions as there are predictor variables. The spread (radius) of the RBF function may be different for each dimension. The centres and spreads are determined by the training process. When presented with the x vector of input values from the input layer, a hidden neuron computes the Euclidean distance of the test case from the neurons centre point and then applies the RBF kernel function to this distance using the spread values.

3. Output Layer

The value coming out of a neuron in the hidden layer is multiplied by a weight associated with the neuron (w_1, w_2, ...,w_n in this figure) and passed to the summation which adds up the weighted values and presents this sum as the output of the network. The bias value of 1.0 (not shown in the figure) that is multiplied by a weight w_0 and fed into the summation layer. For classification problems, there is one output (and a separate set of weights and summation unit) for each target category. The value output for a category is the probability that the case being evaluated has that category.

The radial basis function in the hidden layer produces a significant non-zero response only when the input falls within a small localized region of the input space. Each hidden unit has its own receptive field in input space. An input vector xi which lies in the receptive field for centre c_j, would activate c_j and by proper choice of weights the target output is obtained. The output is given as

$$\boldsymbol{y = \sum_{j=1}^{h} \varphi_j \omega_j,\ \varphi_j = \varphi(\|x - c_j\|)}$$

The different radial functions are given as follows

Gaussian Radial function $\boldsymbol{\varphi(z) = e^{\frac{-z^2}{2\sigma^2}}}$

Thin Plate spline $\boldsymbol{\varphi(z) = z^2 log z}$

Quadratic $\boldsymbol{\varphi(z) = (z^2 + r^2)^{1/2}}$

Inverse quadratic $\boldsymbol{\varphi(z) = 1/(z^2 + r^2)^{1/2}}$

Here $\boldsymbol{z = \|x - c_j\|}$

The most popular radial function is Gaussian activation function

Learning in RBFN

Training of RBFN requires optimal selection of the parameters vectors c_i and w_i, i = 1; _ _ _h. Both layers are optimized using different techniques and in different time scales. Following techniques are used to update the weights and centres of a RBFN.

1. Pseudo-Inverse Technique
2. Gradient Descent Learning
3. Hybrid Learning

Training RBF Networks

The following parameters are determined by the training process

1. The number of neurons in the hidden layer.
2. The coordinates of the centre of each hidden-layer RBF function.
3. The radius (spread) of each RBF function in each dimension.
4. The weights applied to the RBF function outputs as they are passed to the summation layer.

Conclusion

This paper presents a high-speed face recognition method based on the techniques of DCT and RBF neural networks. Facial features are first extracted by the DCT which greatly reduces dimensionality of the original face image as well as maintains the main facial features. Compared with the well-known PCA approach, the DCT has the advantages of data independency and fast computational speed. Besides, we have explored another property of DCT. It turns out that by simply discarding the first DCT coefficient, the proposed system is robust against uniform brightness variations of images. Furthermore, by discarding the first few low-frequency DCT coefficients, the effect of no uniform illumination can be alleviated. The architecture and parameters of RBF neural networks are determined according to the distribution properties of the training samples. Simulation results on three benchmark face databases show that our system achieves high training and recognition speed, as well as high recognition rate. More importantly, it is insensitive to illumination variations.

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