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TIME MONITORING AND COUNT ANALYSIS USING QR CODE SCAN

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Abstract: The formation of crowd in small local shops is inevitable. After the pandemic, situation has changed to such an extent that avoiding the crowd in closed compact spaces would be a priority. Hence, considering this priority, crowd estimation would be of great help. Here, we present a technique for crowd estimation by monitoring the time thus preventing a crowd formation. This approach is implemented with the aid of QR Code Scanning method.

***Index Terms* – Crowd, Machine Learning, QR Scan, Pandemic, Compact Spaces.**

I. INTRODUCTION

Due to the asymptomatic spreaders of the pandemic, people instinctively tend to avoid compact and closed spaces since they might become a potential crowd formation situation. It would result in local retailers with less customers. This situation could be addressed by monitoring and controlling the crowd. A small attempt of achieving this could be by the use of QR Scanning methodology. It can be used to detect the movement and monitor the time and can establish a count analysis. QR Code Methodology would be beneficial since it can be of adequate use for small retailer shops. The ML algorithms used for time prediction are similar to those of Time series. The real time is predicted by considering the previous time values. This attempt of time prediction is being made based on the Linear Regression algorithm along with time series analysis.

II. PROPOSED APPROACH

2.1 TIME SERIES ANALYSIS

Time series is a statistical technique of collection of data in series of particular time periods or intervals. It works on a collection of observations obtained through repeated measurements over time.

A classic method for time series analysis is as follows:

1. Find the main features of the time series such as trends, seasonal components and outliers.
2. Remove the trend and seasonal components to get a stationary, detrended and deseasonalised time series.
3. Choose a model that fits the stationary time series.
4. Use the model for forecasting of the model residuals.
5. Add the previously removed trends and seasonal components to the prediction to get a forecast of the original data

For prediction of next values, the data set being used has a stationary. It implies that mean and autovariance functions do not change with time, thus independent models for future behaviour can be constructed.

For a time series $\{X_t\}$, the mean function $\mu_X(t)$ is defined as

$\mu_X(t) = E[X_t]$,

and the covariance function $\gamma_X(r, s)$ as

$\gamma_X(r, s) = Cov(X_r, X_s) = E[(X_r - \mu_X(r))(X_s - \mu_X(s))]$

A time series $\{X_t\}$ is weakly stationary if

(i) $\mu_X(t) = \mu, \forall t \in Z$,

(ii) (ii) $\gamma_X(t + h, t) = \gamma_X(h), \forall h, t \in Z$.

The autocovariance function $\gamma_X(h)$ function are the tools that are defined as

$\gamma_X(h) := \gamma_X(t + h, t)$

and partial autocovariance is defined as

(i) $\alpha_X(0) := 1$,

(ii) (ii) αX(1) := ρX(1),
(iii) (iii) αX(h) := ρX(Xh+1 − PX2,...,XhXh+1, X1 − PX2,...,XhX1), h ≥ 2,

where PX2,...,XhXn is the best linear predictor of Xn given X2, . . . , Xh.

The sample versions, which can be calculated from real time series data, are
γˆX(h) = 1 n nX −|h| t=1 (xt+|h| − x¯)(xt − x¯), −n < h < n,

$$\rho\hat{}X(h) = \frac{\gamma\hat{}X(h)}{\gamma\hat{}X(0)},$$

and
(i) αˆX(0) = 1,
(ii) αˆX(1) = ˆρ(1),
(iii) αˆX(h) = ˆρ(Xh+1 − PX2,...,XhXh+1, X1 − PX2,...,XhX1), h ≥ 2.

Model – VAR (Vector Autoregressive) model is used in this project.
Xt = ν + A1Xt−1 + . . . + ApXt−p + Ut ,
where Xt = (X1,t, . . . , Xn,t) >, ν is a n × 1 vector holding model constants, Ai are n × n square matrices with model parameters, E[UtU> t] = Σ, E[UtU> t−k] = 0 for k 6= 0, and Σ is a positive definite covariance matrix [18, 31]. All VAR(p) models can be rewritten as a VAR(1) model with
X = BZ + U,
Where
(i) X := [X1, . . . , Xt],
(ii) B := [ν, A1, . . . , At],
(iii) Zt := [1, Xt , . . . , Xt−p+1] >,
(iv) Z := [Z0, . . . , Zt−1], U := [U1, . . . , Ut].

Prediction –
The best linear predictor Yˆ of Y in terms of X1, X2, . . . , Xn is
Yˆ = a0 + a1X1 + . . . + anXn,
with constants a0, a1, . . . , an chosen such that
the mean square error E[(Y − Yˆ) 2] is minimized. The predictor is determined by
Cov(Yˆ − Y, Xi) = 0, i = 1, . . . , n.
In the case of the VAR processes used, the best linear predictor fulfilling this requirement is
Xˆ t = A1Xt−1 + . . . + ApXt−p

2.2 LINEAR REGRESSION

Linear regression analysis is the most widely used of all statistical techniques: it is the study of linear, additive relationships between variables. Let Y denote the "dependent" variable whose values you wish to predict, and let $X_1, \ldots, X_k$ denote the "independent" variables from which you wish to predict it, with the value of variable X_i in period t (or in row t of the data set) denoted by X_{it}. Then the equation for computing the predicted value of Y_t is:

$$\hat{\mathbf{Y}}_t = \mathbf{b}_0 + \mathbf{b}_1\mathbf{X}_{1t} + \mathbf{b}_2\mathbf{X}_{2t} + \ldots + \mathbf{b}_k\mathbf{X}_{kt}$$

This formula has the property that the prediction for Y is a straight-line function of each of the X variables, holding the others fixed, and the contributions of different X variables to the predictions are additive. The slopes of their individual straight-line relationships with Y are the constants $\mathbf{b}_1$, $\mathbf{b}_2$, …, $\mathbf{b}_k$, the so-called coefficients of the variables. That is, $\mathbf{b}_i$ is the change in the predicted value of Y per unit of change in X_i, other things being equal. The additional constant $\mathbf{b}_0$, the so-called intercept, is the prediction that the model would make if all the X's were zero (if that is possible). The coefficients and intercept are estimated by least squares, i.e., setting them equal to the unique values that minimize the sum of squared errors within the sample of data to which the model is fitted. And the model's prediction errors are typically assumed to be independently and identically normally distributed.

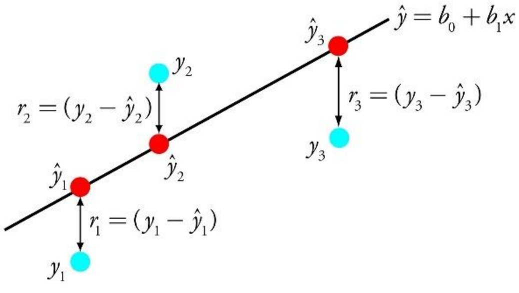

Figure 1. Linear Regression

III. EXPERIMENTAL RESULTS

To see the effectiveness of the time series data visualization, a raw sample dataset is provided consisting of the date-time factors. On the basis of the provided dataset, the time series data is plotted in the form of Histogram Plot and line plot.

The result is as shown below.

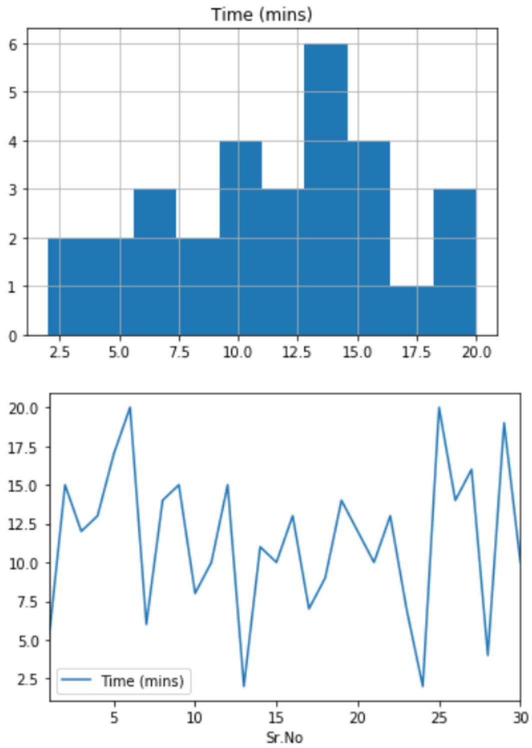

Figure 2. Histogram Plot and Line Plot

IV. CONCLUSION

This paper addressed the time monitoring characteristics using the Time series analysis. Linear Regression Algorithm was used to predict the future values of the target variables based on the resulting dataset from time series forecasting.

The proposed method would reduce the formation of a cluster in small compact spaces and would form an analysis of the daily crowd in local retailers' shops.

The project results indicate an optimized graph of a clusters time analysis in a given local space based on the collected dataset.

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