IOT Based Automatic Gas Cylinder Booking using Time Series Forecasting Model

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Abstract: In the current run-off, we did not realize how much level of LPG gas cylinder was. After the gas cylinder is gone, then our star flies. It is remains cooking and many more. We get gas cylinder two or three days after it is booked. To get rid of these things passes we proposed automatic monitoring level of LPG gas all the time and predict when to gas cylinder became empty. It automatically books the gas cylinder 2-3 day before the cylinder became empty.

In this paper to monitor the level of LPG gas we used load sensor and microcontroller that continuously send the weight of cylinder to server. To predict, when cylinder became empty we used autoregression model. According to prediction we send SMS to LPG gas agency to book the cylinder.

Keywords—IOT, Prediction, Autoregression

I INTRODUCTION

The liquefied petroleum gas is used widely in homes, industries and in auto mobiles as fuel. When to book gas cylinder is very difficult task. We can't monitor the level of gas manually every day. If we book the cylinder after it going to finish, we are in trouble till we get new one or if we book earlier, we get new cylinder in replacement of old one. We have loss of some gas. It is not properly utilization of our money that we paid for cylinder.

It is necessary to book cylinder at right time so in this paper we used the consumption of LPG for every day data and using this time series data we forecast the when cylinder became empty and when to book cylinder.

This paper is organized as follows. Section 2 describes state of art. Section3 describe methodology used for this project. Sections 4 explain the prediction model. Section 5 shows the result of prediction. Finally, Section 6 presents our conclusions.

II LITERATURE REVIEW

There are very few existing work has been done for the same requirement but all of them use sensor, microcontroller and GSM module. Using ARM processor detects the gas leakage and alerts the consumer about leakage by SMS [1][2]. To monitor the level of the LPG present in the cylinder using load sensor with gas leakage detection proposed by [3]. Apart from this if gas level goes down below the threshold an SMS send to the gas agency to book for cylinder [4]. In additional to level monitoring and gas leakage, use of temperature sensor to detect the temperature of surrounding if there is a chance of fire and alerts the user [5] instead of using controller used processor.

III METHODOLOGY

Fig. 1. Conceptual System

The figure 1 shows the Conceptual System. It consists of three things, 1) gas weight sensor and microcontroller, 2) Server and 3) mobile.

Gas weight sensor and microcontroller

Gas weight is monitor using three components, Arduino, load cell and WiFi Shield. The figure 2 shows the block diagram of gas level monitoring. The load cell measure the weight of gas cylinder and the wifi-module send this weight to the server.

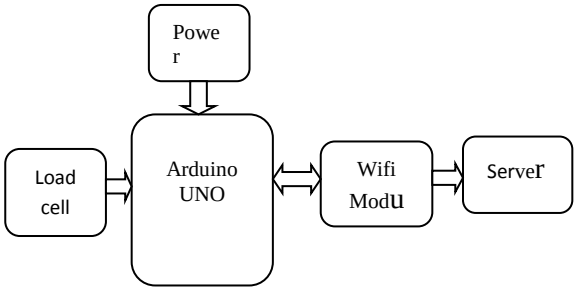

Fig. 2. Block diagram of gas level monitoring

Server

On the server, data of LPG gas cylinder weight was stored in data base and calculates daily consummation of gas. Using autoregresion prediction module with lag 6 (AR(6)) calculate how many days user can consume the gas before to became cylinder empty. If the number of days is exactly same as booking to deliver days time span then server send the SMS to gas agency to book the cylinder.

IV PREDICTION MODEL

A time series is a sequence of measurements of the same variable(s) made over time. In our case, gas consumption per day. An autoregressive model is when a value from a time series is regressed on previous values from that same time series. For example, yt on yt−1:

$$y_t=\beta_0+\beta_1 y_{t-1}+\varepsilon_t.$$

In this regression model, the response variable in the previous time period has become the predictor and the errors have our usual assumptions about errors in a simple linear regression model. The order of an autoregression is the number of immediately preceding values in the series that are used to predict the value at the present time. We wanted to predict y current day (yt) using measurements of gas consumed in the previous sex days (yt−1,yt−2, yt−3,yt−4, yt−5,yt−6), then the autoregressive model for doing so would be:

$$y_t=\beta_0+\beta_1 y_{t-1}+\beta_2 y_{t-2}+\beta_1 y_{t-3}+\beta_2 y_{t-4}+\beta_1 y_{t-5}+\beta_2 y_{t-6}+\varepsilon_t.$$

This model is a sixth-order autoregression, written as AR(6), since the value at time t is predicted from the values at times t−1 to t−6.

Using this model the process of making a prediction involves the following steps:

The model is trained on all available data and saved to file for later use.

The saved model is loaded and used to make a forecast.

Elements of the model are updated in the presence of new observations.

V EXPERIMENT AND RESULT

The evaluation and simulation is carried out in Python. The three months data for LPG gas consumed per day in grams are store and last month data is used for to build the model. The evaluation is on training data to predict next three days shown in Table 1.

The figure 4 shows the prediction of the next three days gas will consumption and figure 5 shows the one step-ahead prediction of gas consumption. From the table and graph the autoregression model is not too good but it can be considered for rough estimation.

In figure 3 on 32nd day total gas consumed is 13247g and remaining gas in cylinder is 953 g. From the prediction of the next three days, 33rd, 34th and 35th gas will consumes 422.4777 g, 448.8963 g and 420.4656 g respectively. It is clear that after next tow day cylinder became empty so on 33rd day is right day to book cylinder if the time span is two day to deliver the cylinder after the booking.

TABLE 1. EVALUATION ON TRAINING DATA

	1-step-ahead	**2-step-ahead**	**3-step-ahead**
N	25	24	23
Mean absolute error	39.9317	38.6358	37.7348
Root relative squared error	68.5067	68.5067	60.8199
Direction accuracy	58.3333	60.8696	59.0909
Relative absolute error	69.614	69.614	62.1261
Mean absolute percentage error	9.865	9.474	9.1865
Root mean squared error	46.2869	44.9611	44.229
Mean squared error	2142.48	2021.5	1956.21

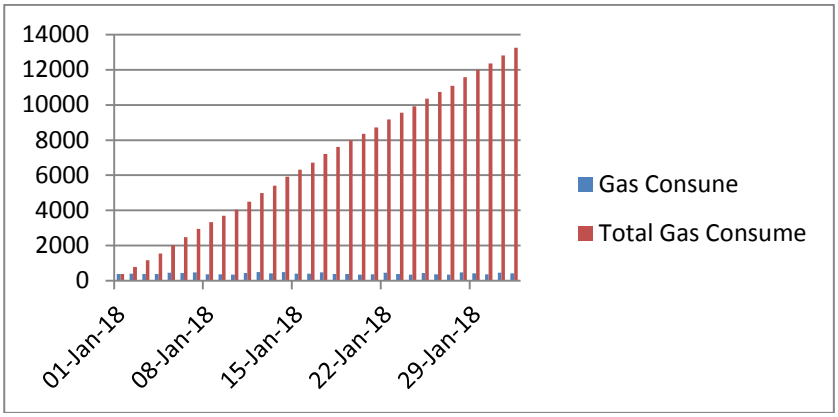

Fig. 3. Daily & total gas consumption.

Fig. 4. Future forecast for next three days gas consumption.

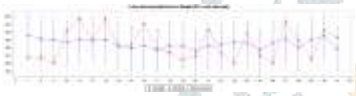

Fig. 5. One Step-ahead prediction for gas consumption.

VI Conclusion

The system of detecting gas level and automatically booking it when the gas is about to complete is designed and implemented in this paper is cost-effective. This proposed system fulfils the approach to book the gas efficiently. To get more appropriate prediction of when cylinder will empty instead of autoregression model more prices model can be used such as support vector regression.

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