



# Neural based RBF and LVQ Network Model of Knowledge Representation in the Prediction of Mobile Location

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## Abstract

In mobile communication system, mostly the Location based services and quality of services have need of information about the mobile station location. If the cellular communication system knows the movement of the subscriber is preplanned, and exceedingly passionate about the mobile subscriber's personal characteristics. Thus prediction of mobile location is mainly essential matter to give the location based quality of service to the subscribers [8]. Neural network has several network models that can be utilized to predict mobile location and preparation parameters can be collect from the individual portability of the subscriber. In this paper our contribution is that RBF network techniques and LVQ be use to forecast the subscriber's next locality based on the present locality [6]. The MATLAB software was making use of substantiate the constraints of Radial Basis Function network structure and also the similar training facts to LVQ network. At first, the execution of the LVQ (Learning Vector Quantization), RBF (Radial Basis function) [13] has been considered. Our real commitment in this paper is that we prepared neural system utilizing the data about adjusting cell and neighboring cells, collected from a drive analyzer Reality mining on specific ways demonstrating the genuine Mobile Station (MS) area.

**Keywords:** Neural network, LVQ, RBF, Mobile Location, Reality mining data.

## 1. Introduction

In the future mobile communication network schemes are going to provide expenditure of use and appropriate provisions to the mobile subscriber by different characteristics.

The most important mobile communication network services are location based service and quality based service. In mobile communication systems, when the subscriber can have the call from mobile network, necessitate to trace the subscriber properly and proficiently in order to find the phone calls aptly [6]. Location based service is a knowledge based system available on mobile through network and services provided based on subscriber location data and geographical location [2].

A few strategies has projected to anticipate the prospect location of the mobile client in light of the accessible recorded data [6]. To point out the location by neural network, it is assumed that every mobile encompasses a mobility pattern associated with personal specifications of the mobile user and also the cell. In the recent years, various works were done for prediction of mobile locations in wireless networks using neural network [4].

The Neural networks trained through back propagation and used to categorize mobile location prediction methods [1]. Nevertheless, the time taken of train the networks is able to show troubles, predominantly while examined a mixture of characteristic sets to symbolize drive analyzing reality mining data sets [1]. In this article contrast the recital of different substitute neural network models

such as Radial Basis Function networks (RBF) versus Learning Vector Quantization networks (LVQ) [1]. Training speed, network evaluation speed and classification accuracy be measured. The result of condensed exercise data is also evaluated for the two networks [1].

In this research paper we have a tendency to investigate mobile location prediction using neural network techniques. Whatever remains of the paper is sorted out as takes after. Segment II is dedicated to a literature survey on mobile location techniques while in segment III we talk about two neural systems that are utilized for location estimation. The test consequences of recreations representing the execution of the each RBF and LVQs depicted in segment IV. Segment V presents results of utilized neural system and finally the conclusions are given in segment VI.

## 2. Literature Study

Lin et al (2012) discovered that the individual lobby group a manner is a vital subject for forecast of car travel and unfold catching problems [14]. Hsian et al (2008) studies, since mobile medium network might with efficiency observe the motion of phone abuser; the telecommunications micro mobility will be a perfect system for learning individual's lobby group harms [10].

In light of the perception that most client portability is nearby to an trustworthy area, various leveled versatility administration plans were proposed as of late reported by Akyildiz and Wang (2002) and Sungwon et al (2012) [5].



The cellular phone IP (Internet Protocol) address be utilized to deal with periodic movement of data flow control and mobile network improved plans be utilized to oversee visit small scale mobility [5]

The concert of capacity replica and consideration of wireless network system and mobile network systems are explained by Kirsal, Y. et al (2011). In cell network, the complication of the future creation wireless techniques and mobile phone systems, concert assessment is necessary to get better the design according to the quality of service necessities and concert distinctiveness of the mobile network [12].

A node movement supervision practice for join together mobile ad hoc network using Tree Based Routing Protocol and connection networks suggested by Hoon and Phan (2007) [11].

To make simple and quick handoff, constant area following was talked about by Qiang and Acampora (2002), and Anantharam et al (1994) answered to diminish the area refresh overhead in IP based versatile systems, various leveled IP portability administration plans were viewed as vital [8].

The requirements for the movement protocol of third generation cellular phone network were discussed by Verkama et al (2002). The location movement protocol is utilized to relocate mobile user's facts among cellular network essentials and structure starting point wandering [9].

Mobile phone IP address is the recent set for sustaining movements in Internet Protocol networks. Excluding it be deficient in hold for speedy gadgets control, concurrent position pathway was investigated by Sami (1995) and Madhow (1994) [5].

### 3. RBF Network Model and LVQ Network Model

#### 3.1. RBF Network Model Representation

Generally the concealed units are used in RBF (radial basis function) network with restricted receptor pastures. The RBF arrange shrouded unit can be thought of as speaking to a point in N-dimensional space which reacts to enter vectors whose Cartesian directions are near those of the concealed unit, where N is the quantity of highlights in the information portrayal. Many exchange capacities might be utilized for the shrouded units yet the most widely recognized is Gaussian, which gives a reaction that drops off quickly as the separation between the concealed unit and the info vector increments and is symmetrical about the spiral pivot. The rate with which the reaction rate is immovable by the concealed unit spread. The yield layers of a RBF arrange is straight. The test of outlining a RBF arrange lies in appropriately putting concealed layer neurons and picking an ideal incentive for the spread consistent to such an extent that the whole information space of intrigue is secured with least cover. These choices are normally made observationally, instead of over the span of routine preparing forms [1].

The most important benefit of the RBF network is habitually measured to be its little training instance in contrast with Back Propagation, even if the working out and storage space necessities for categorization of participations subsequent to the network is skilled is typically better [1].

Radial basis function method was first proposed by Powell. Radial basis function has only one hidden unit. These networks are feed forwarded [16]. The structure of Radial basis function is illustrate in Figure 1

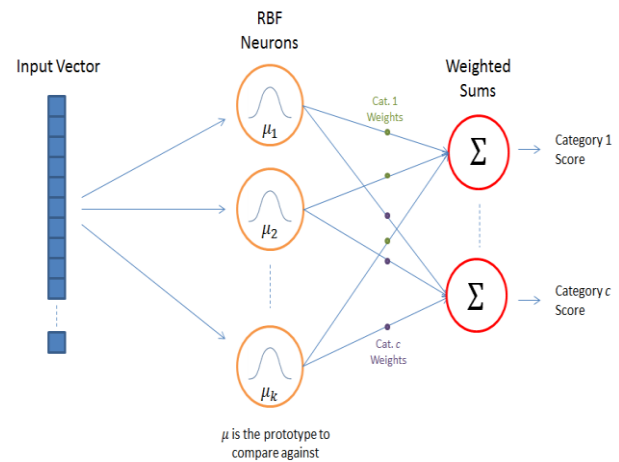


Fig. 1: The structure of an RBF Network

The above figure demonstrates the configuration of a Radial Basis Function Network model, and it includes layer of neurons and input vector, then a output layer with only one node per group.

#### 3.2. LVQ Representation

The representation of LVQ make use of a self-organizing network method, it utilizes the exercising vectors to continuously desist the assignment viable concealed units that symbolize grouping of the contribution. Previously the LVQ was undergone training; the input vector is sort out and fit in to the group signified by the adjoining hidden part. The consideration of hidden units may be contain hindering associations among each other so that the part between the most important input wins and hold back all the extra parts to expose that just the winning part generate an output. The simulations of the computer, there is no authentic restrain associations and the conqueror is just the concealed unit is very close to the contribution unit by the Radial Basis Function, all the concealed part be able to observe instead of a spot in N-dimensional space. Together network categories the yield of the concealed units are based on the propinquity of the contribution unit. The difference between these two networks is that, in the type of RBF network is there are quite a few Gaussian hidden units be able to contain considerable outputs, whereas in the network type of LVQ the yield of all but one spirited part is nil. The concluding yield together network categories are resolute through the weights of the linear yield part [1].

To train the Learning Vector Quantization network is consummate by giving the contribution units and regulating the place of concealed units based on their closeness to the participation unit. The adjacent concealed unit is stimulated detachment relative to the erudition rate towards the skilled vector if the group of the concealed unit and the skilled vector match, and left if they do not. The concealed unit weights are skilled in this mode for an illogical amount of iterations, frequently with the erudition rate lessening as exercising developments. The main aim is to place the concealed units thus the result sections of the exercising part are covered [1].

In pattern classification Learning Vector Quantization networks are accomplish well. Radial Basis Function networks be inclined to have very small exercising time necessities [1]. LVQ is entirely fluctuating from Kohonen Self-Organizing Maps and Vector quantization; fundamentally it is a spirited network which employs supervised learning technique. May perhaps define the course of pattern classification; the patterns everyplace all yield part symbolize a class and it is used in supervised learning, the LVQ network will be set a group of training patterns by way of identified categorization beside with an primary allocation of the yield class.

Once the pattern training process over, Learning Vector Quantization will organizing a contribution vector via transfer it to the similar set of the yield unit [3].

The below Figure 2 explains structural design of Learning Vector Quantization, it is somewhat related to structural design of Kohenens Self Organizing Maps. Here there are “n” quantities of contribution units and “m” quantity of yield units is used. The input and output levels are completely interrelated by weights with itself [3].

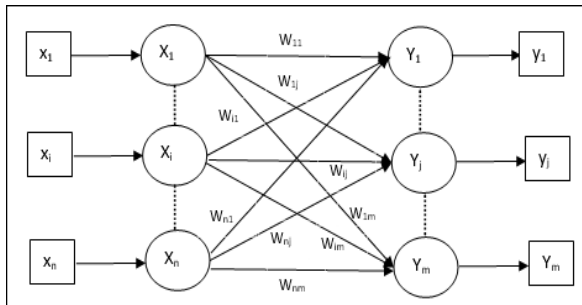


Fig. 2: LVQ Structure

The below constraints are utilized in training process of learning vector quantization as well as in the structure [3]

$x$  = training vector ( $x_1, \dots, x_i, \dots, x_n$ ) [3]

$T$  = class for training vector  $x$  [3]

$w_j$  = weight vector for  $j^{\text{th}}$  output unit [3]

$C_j$  = class associated with the  $j^{\text{th}}$  output unit [3]

## 4. Implementation

### 4.1. Description of the Data Set:

In our research matlab software is used for implementation process. In this research we use Reality mining data set, it is used to complete by ninety four of the one hundred and six Reality Mining subjects in the course of assessment data [2].

This survey enclosed two queries relating to the typical reportable proximity and relationship with the opposite subjects, also as queries regarding the individual’s general satisfaction along with his or her work cluster. the truth Mining project was conducted from 2004-2005 at the university Media Laboratory. the truth Mining study followed xciv subjects exploitation mobile phones pre-installed with many items of code that recorded and sent the investigator information regarding decision logs, Bluetooth devices in proximity of roughly 5 meters, cell tower IDs, application usage, and phone standing. Subjects were discovered exploitation these measurements over the course of 9 months and enclosed students and school from 2 programs at intervals a significant analysis establishment. Conjointly collected self-report relative information from every individual, wherever subjects were asked regarding their proximity to and society with others [2].

This exploration examination, we connected a division of the information gathered for the Reality Mining study, joining the 94 subjects that had finished the study. Of these 94 subjects, 68 were partners working in a similar expanding on grounds (90% graduate understudies, 10% staff) while the rest of the 26 subjects were approaching understudies at the college’s business college. The subjects volunteered to wind up some portion of the trial in trade for the activity of a most recent rendition advanced mobile phones amid this correction [4].

### 4.2. Implementation:

In this paper we are used matlab software tool, Reality mining data set is used to conduct the research. This article focuses on two neural based network models such as RBF network and LVQ network. The matlab software was employed to verify the RBF network constraints and the similar training data set is used for LVQ network [6]. Our real commitment in this paper is that we prepared neural system utilizing the data about adjusting cell and neighboring cells, collected from a drive analyzer Reality mining on specific ways demonstrating the genuine Mobile Station (MS) area.

The networks are examined on the reality mining data set, which consisted of 94 of the 106 Reality Mining subjects through Reality mining dataset. An exercising data group and an estimation data group are utilized for working out and trying the data set. The comparative volume of these data sets matching to the rate of incidence of the mobile locations in the Reality mining data model [1].

The tests accomplished this learning; job of all neural networks is to order an input vector as only two fields such as time and cell id on which it was trained. The comparison results of LVQ and RBF networks are shown below section [1].

### LVQ Network Output:

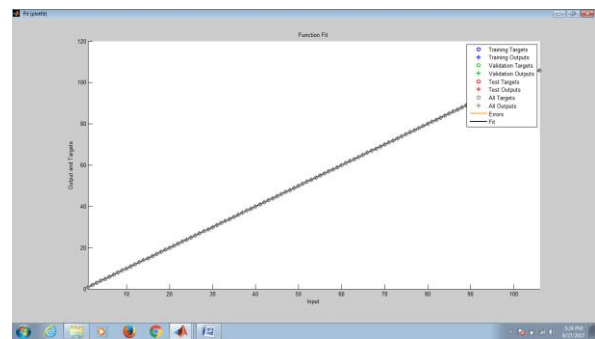


Fig. 3: Test network

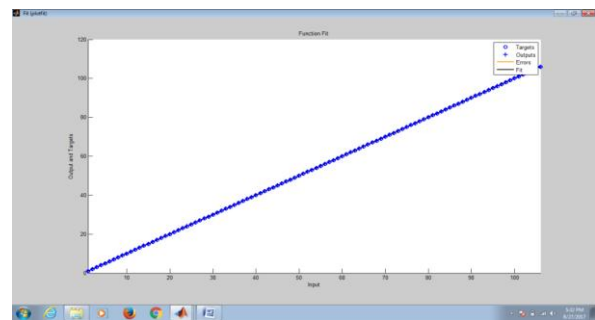


Fig. 4: Function Fit

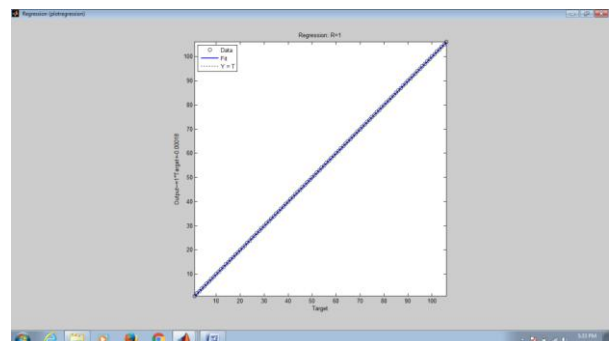
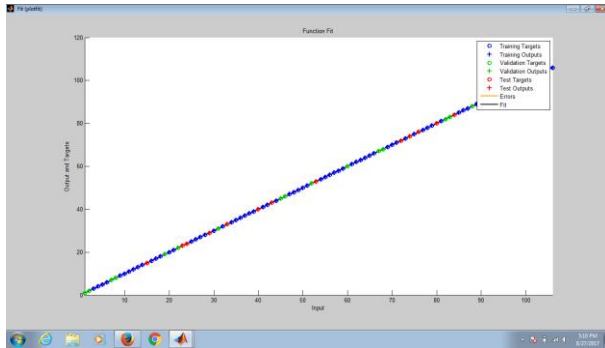
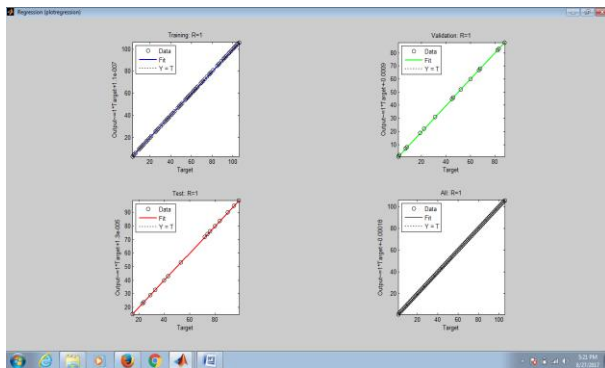


Fig. 5: Regression of LVQ

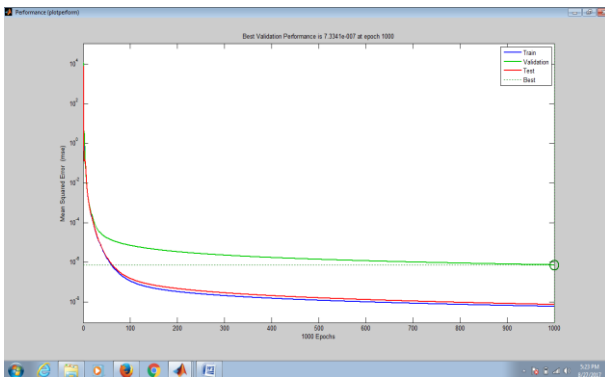
**RBF Network Output:**



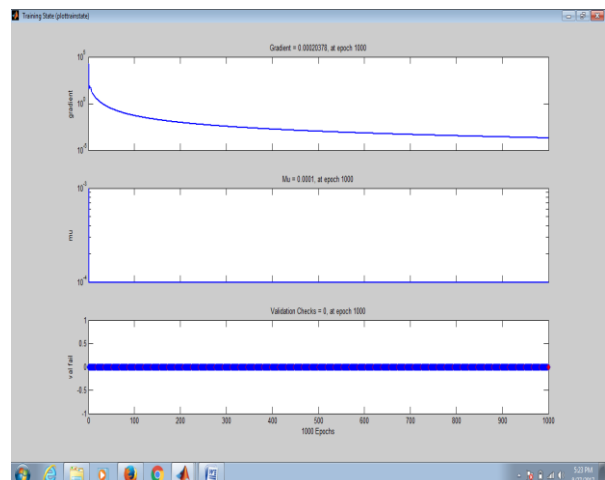
**Fig. 6:** Function Fit of RBF Network



**Fig. 7:** Regression chart of RBF network



**Fig. 8:** Validation performance



**Fig. 9:** validation result

**Scrutiny:**

Despite the fact that the routine classification claim on the mobile phone collides rarely owing to regular restarts, these collapses do not effect in important data defeat. On the other hand, though the sorting claim can be unspecified and to be operating always the handset is in lying on mode, the data group spawned be surely having noisy data. For this reason we can identify after each issue initiated this investigation, in addition to the records that contain is monitored, we identify precisely once we are lost data. These lost or misplaced data are occurring from two main mistakes the first one is data corruption and the second one is powered-off gadgets [2].

A cellular phone has response once it is surrounded by the range of a fixed cellular tower. Whereas the majority of cellular phone towers have extending their range to quite a lot of open area regions, in emblematic metropolitan area makings cellular tower compactness are considerably advanced. Each tower has been allocated cellular tower identification (Tower ID) that is registered by the cellular phones in this investigation. As an outcome of the cellular tower identifications (Tower ID's) and particular evolution epochs, it has been publicized that a cellular phone's place can be contained within the range of one hundred to two hundred meters in urban region [2].

**5. Evaluation Outcomes**

By using neural network toolbox of MATLAB software package, all the networks were simulated. The intention of this testing was to contrast the comparative concert of two network categories, and it has not construct well-organized neural network system [1].

**5.1. In RBF Network Model**

This scheme accustomed training the RBF hidden layer was to assess all contribution as a potential position for a concealed part, so pick the placement that consequences within the slightest range of wrong instances. This method is recurrent till required range of hidden parts was institute. Vector quantization algorithmic program exist accustomed scale back training groups, so the networks are trained, after the trained networks are assessed on the first training group [1].

The two primary variables that are pretentious concert were the measure of hidden units used and therefore mathematician unfold. Most effective worth for unfold invariable modified because the range of hidden parts multiplied, because the compactness of concealed parts in vector house multiplied. On behalf of the networks of lesser with ten concealed units, a variety worth of nine made the most effective categorization correctness for mobile location prediction [1].

The precision of order of the preparation set expanded with the quantity of concealed units; in any case, speculation corrupted with huge quantities of shrouded units and the measure of calculation required for both preparing and assessment was likewise significantly expanded. Nine shrouded units created the best trade off of grouping precision and calculation trouble [1].

**5.2. In LVQ Network Model**

The most important issues that restricted the actions of the Learning Vector Quantization network are the quantity of concealed layer parts, network knowledge tempo and the moment in time to train the network. There are 2 absolutely unusual techniques for groundwork assignment of the hidden layer units is attempted, unsystematic assignment and assignment of all the hidden layer units at the worth of the training data group. The network models appeared steady a

similar answer is not an awkward about the participation of the hidden layer weights [1].

The simplification capability of the networks appeared to diminish as hidden units are accessorial. The research run over all one hundred twenty reality mining data subset pairs designated that the simplest Learning Vector Quantization presentation for this function was accomplished with solely two hidden units trained with a hundred input vector appearances [1].

### 5.3. Results for the Comparison of Two Networks

The most excellent outcomes for networks of Radial Basis Function and Learning Vector Quantization are outlined in Section IV. Grouping exactness is displayed as a normal of every one of the 106 reality mining information match systems [1]. Assessment of execution of the single networks uncovered that in cases, in which one subset of reality mining dataset a couple have more number of information vectors compared with other network, the methods of back propagation is be inclined to support subsets of reality mining data set with more information sources, grouping a substantially more prominent level of little group inaccurately compared with the bigger one. Neither the Radial Basis Function nor the Learning Vector Quantization frameworks encountered this issue [1]. The MATLAB tool revealed generally double the quantity of coasting guide activities toward prepares each networks for Radial Basis Function contrasted with Learning Vector Quantization. In any case, the time required to prepare a system with Radial Basis Function was around ten times that required for a Learning Vector Quantization network [1].

## 6. Conclusion

The RBF and LVQ network models into consideration are highly developed within the provisions of classification accurateness to feed forward perceptrons skilful through Radial Basis Function network. The RBF network move toward really close to corresponding the accurateness by manner a so much small training time, and appeared to maintain its generalization ability above LVQ division, on one occasion trained on a fundamentally reduced input values of the data set. These unit every essential problems in neural network based mostly mobile location prediction.

The LVQ network has a smaller amount precise compared with feed forward multi-layer perceptrons trained networks and it completely a little extent that the foremost wonderful performance was earned solely 2 hidden layer units. Though it's not correct because the RBF networks and LVQ network have entirely 2 hidden layer units might be helpful in mobile location prediction. Whereas along training time and estimation times are significantly small.

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