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TRACKING OF MOBILE USERS IN WIRELESS NETWORK

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Abstract- To track the correct location of a mobile user is a critical role for location services in an indoor environment. Low complexity, low power and low cost are the sole characteristics of wireless sensor network. Indoor position system performance can be improved drastically with these properties. Scattering diffraction, and reflection has adverse effect on radio signal propagation, therefore the received signal strength requires good calibration method to provide correct position. Grey prediction method is used in this paper for wireless sensor network and it makes use of wireless techniques (Zigbee/802.15.4). Grey prediction predicts Received Signal Strength Indicator (RSSI) and Dynamic triangular (DTN) location method is also designed. Mean distant error of RSSI at offline stage on mobile user can be within 2.3m for performance analysis. In run time stage, grey prediction give more exact predicted position and carries out mean distance error within 1.3 m.
Keywords- **RSSI, DTN, Zigbee, Wireless sensor network, Mean distant error.**

I. INTRODUCTION

A wireless sensor network (WSN) is a distributed collection of nodes which are resource constrained and capable of operating with minimal user attendance. The nodes are distributed spatially to cooperatively monitor physical or environmental conditions, such as sound, pressure, temperature, motion, vibration or pollutants at different locations [1]. such nodes are usually enclosed and report sensed data to a central base station. The base station (or gateway) can communicate with various wireless sensors via a radio link. Wireless sensor node gather, compressed, and transmit the data to the central base station directly or by the use of other wireless sensor node to forward data to gateway. The connection then send data to the system.

Localization is an inevitable challenge when dealing with wireless sensor nodes. The localization problem has received huge deliberation in the past, because a large number of applications need to know where persons or objects are, and therefore various location services have been created. Localization is usually carried out by measuring certain distance parameters of wireless radio link between the localization node and different localization base stations. There are various localization schemes for the localization of wireless sensor network. In this paper the main idea is comprise on approaches based on received signal strength indication (RSSI). The algorithm enables localization of moveable wireless devices in an indoor enviornment. The algorithm used here (grey prediction) provide low complexity and low cost, hence is most feasible.

II. FRAMEWORK OF SYSTEM

The test-bed for experiment is shown in fig.1. In our case when mobile user moves in building and location of mobile user can be pridicted by location system. Four CC2420BK Demonstration Board Kits labelled S1, S2, S3 and S4 is placed in our laboratory. The mobile user and sensors nodes are equipped with a 2.4 GHz wireless interface (zigbee). The coordinate system is established by sensors node when mobile user moves around in blue colour zone in our laboratory. The system architecture is shown in fig.2. The predicted RSSIs can be computed by grey prediction when each sensor node receives RSSIs generated by mobile user. Predicted RSSIs can be used to estimate the location of mobile user from coordinate system. Different location algorithm such as SMP, DTN, KNN and TN which are used to find the location of mobile user are denoted by coordinate system.

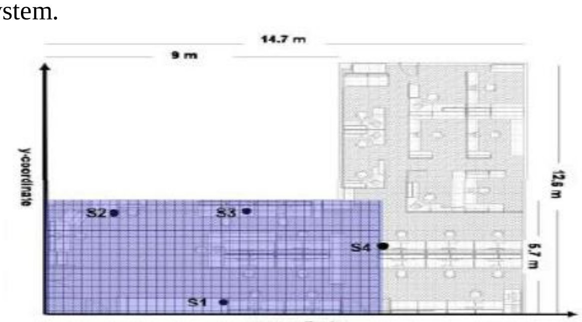

Fig 1. Test Bed

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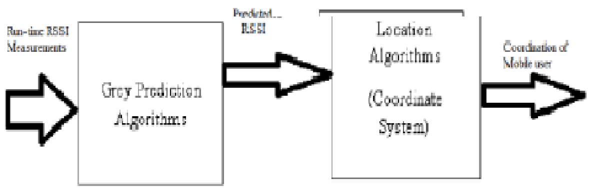

Fig 2: Depicts location estimation system

III. GREY PREDICTION MODEL

To improve the accuracy of mobile user's location we use the RSSI predictive based model. For tracking mobile user, the proposed grey prediction approach [8] utilizes the grey system to predict RSSI. We model the dynamic RSSI of x using first order ordinary differential equations as follow:

$$\frac{dx^w}{dt} + aX(1) = b \qquad (1)$$

X (1) is the accumulated generating operation that can be obtained by
X (1) = (x (1) (1), x (1) (2), x (1) (3),......x (1) (n))
Where

$$(X)^1(k) = \sum_{m=1}^{k} X^m \;, \quad k\mathcal{E}(1\ldots\ldots\ldots n) \qquad (2)$$

X (0) = (x (0) (1), x (0) (2), x (0) (3),......., x (0) (n)) is the original data sequence, where x (0) (k) represents RSSI at time t. Equation (1) is called "white descriptor" for modelling a white system and its parameters (a, b) can be found directly from the observed RSSI.

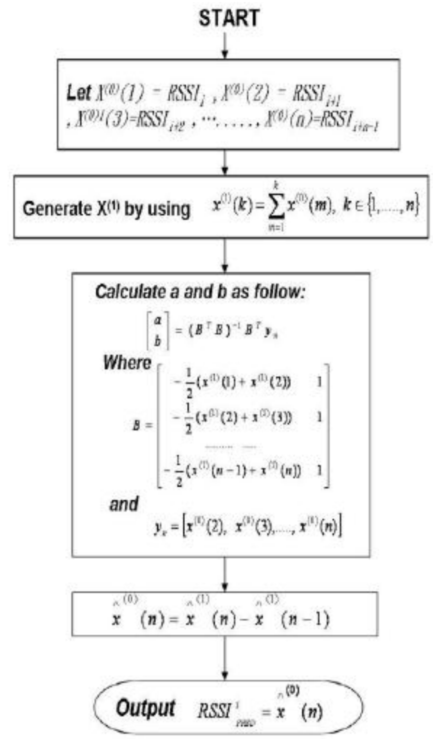

Fig 3. Grey prediction system

The mean square error (MSE) is used to determine the performance of grey prediction system, and at the Runtime stage we put the measured RSSIs which generated from mobile user to the grey prediction system, and then get the predicted RSSI. We compare two methods of grey prediction, one is original grey prediction output, the other is grey prediction with weight method, weight method is used to obtain RSSI, w1 and w2 denote the weighting of original RSSI and predicted RSSI. We measured four different independent sets of RSSIs when mobile user moved away from the same sensor node, and each set of RSSI was measured at different time a day, because signal strength fluctuates from time to time. The number of original RSSI and predicted RSSI are the same 300 and the mobile user move the same distance (6m).The RSSI pred1 is determined by using the grey prediction process that show in the Figure 4 and Figure 5 respectively for predicted and weighted predicted.

RSSIpred2 = w1 × RSSIipred1 + w2 × RSSIi-1

$$\text{MSE1} = \frac{1}{\text{n}}\sum_{i=0}^{n1}\sqrt{RSSI^i pred1 + RSSI}\,\text{i})2$$

$$\text{MSE2} = \frac{1}{\text{n}}\sum_{i=0}^{n1}\sqrt{RSSI^i pred2 + RSSI}\,\text{i})2$$

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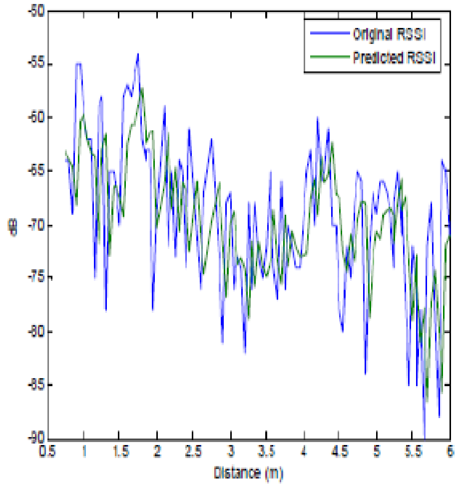

Fig 4. Plot of predicted RSSI

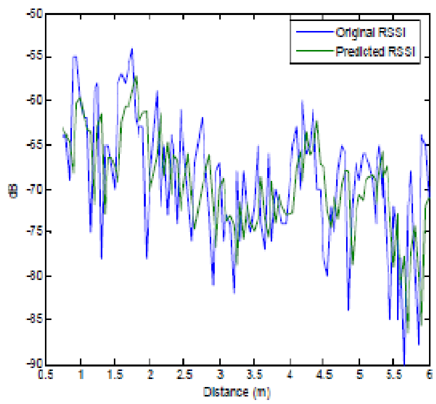

Fig 5. Plot of weighted Predicted RSSI

Grey Prediction with other Location Methods:

There are several location algorithms such as TN, KNN, SMP and DTN which can be integrated with grey prediction methods. The mobile user moves in the direction pointed out by the arrow heads and broadcast the beacons every 50ms. The velocity of mobile user is 0.15m/s. The sensor node again beacons and views RSSIs result to grey prediction algorithm. Now we will compare various approaches. First is the grey prediction method itself and another method is grey prediction with weight. Now these predicted RSSIs are used to estimate the location of mobile user with the true location and the estimated location of mobile user. The true location and the estimated location are recorded when the mobile user is traversing through various nodes.

MDE (mean distance error) is used to evaluate the location of the mobile user. Grey Prediction can reduce errors arising from non-line of sight and predict the tendency of RSSI when mobile user is moving. Thus results predicted with location algorithms are used to predict mobile user location and origination. We change the number of grey prediction inputs and analyse the change which affects the accuracy of mobile user position. The figure 6 shows the mean distance error of several location algorithms which incorporation with grey prediction demonstrates the various variations with grey prediction. KNN and SMP have greater mean distance error than the rest two algorithms in case of less than 100 grey prediction inputs. The mean distance error is smaller in case of DTN. Now when the number grows beyond the limit then the best evaluated error value is 1.3m for DTN. The figure 7 also depicts mean distance by using weight method also.

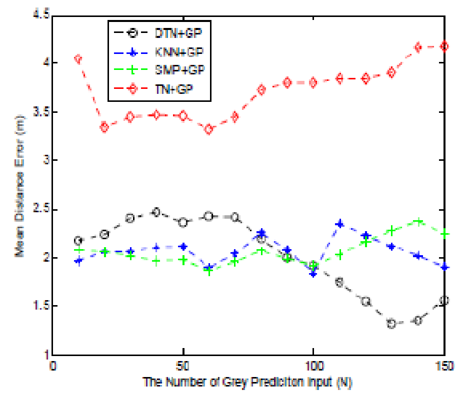

Fig 6. The Grey Prediction Experimental results

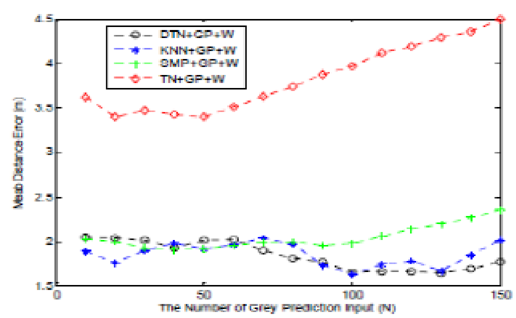

Fig 7. The Grey Prediction experiment with weight method

IV. CONCLUSION

We presented the study of various location algorithms with respect DTN location algorithm for the wireless sensor network along with the employment of grey prediction to improve the accuracy with respect to the others. We have used grey prediction to predict the tendency of RSSI and

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we reduced the fluctuation of RSSI when mobile user is moving.

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