Generic Framework For Handoff In Wireless Sensor Networks With Random Forest Classifier

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Abstract: In contemporary world, uninterrupted mobile or wireless communication between the sensor networks or cellular networks is essential for the smoother communication. Cellular networks are embedded with cells in which every cell is providing the services to the connecting end users. But it supports only limited roaming area. Here handoff or handover is the essential service when a user moves one network into another geographical area without any interruption. A handoff is principle of conveying the signal from one cell in cellular network to other network. Due to heavy traffic, handoff may be triggered because more number of users is accessing the same cell. Hence it paves the interrupted service communication, high latency, less throughput among the users. In this paper, we design the generic framework for handling the handoff process with Artificial Intelligence. Besides this framework not only applicable for Mobile scenario, it will be applicable for all kinds of Wireless Sensor Networks (WSN). Utilization of Machine learning algorithms like, Random Forest Classifier and Hadoop Infrastructures are contributing this paper to lead the high features of the Hand over process.

Keywords: Handoff, Random Forest Classifier, WSN

1. Introduction

In a real world, more number of wireless communication networks has emerged for all geographical areas. Many kinds of WSN signals are becoming come to one point or many points as per users needs. Cellular or other semiconductor signal will form a homogeneous or heterogeneous network. Normally, communication between the two points many be analyzed by the frequency, battery power, low latency and throughput. Recent mobile phones or smart phones are functioned [8] with voice data, textual information and different multimedia and calls with conversion of Radio Frequencies (RF). Base stations (BS) for mobile communication are used for sending and receiving those RF signals with proper network Identification. Further this network is constructed with many overlapping, distinguished geographic area or CELL in BS. Usually smallest CELL area may be situated in urban area and biggest part may be in rural places for easier communication for people. Smart phones are consisted with digital signal processor, microprocessor and flash memories for achieving effective communication over the network. In BS, switching the processor for communicating or transmitting between the end users without any delay is called handoff-mobile mechanism

Soft - Handoff

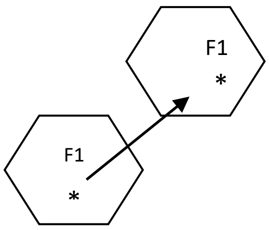


Figure 1 Soft – Handoff

The above shows the mechanism of soft handoff in which how the communication between the Base Stations which is initiated by Mobile Station (MS) with same frequency. It is emphasizing the communication to new Base Station before disconnecting the services from the old Base Station. It is also referred as “Make before Disconnect”

Hard - Handoff

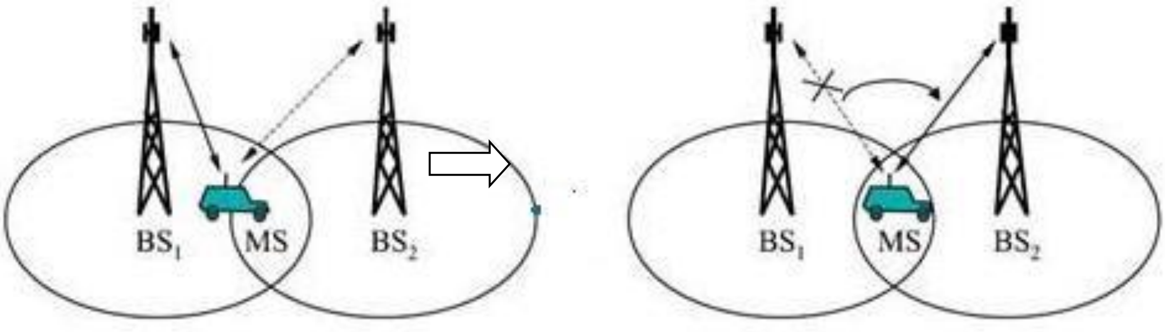


Figure 2 Hard - Handoff

This feature is established by breaking of the services between the BSs. Mobile station may ensure to break the services and it also referred as “Disconnect before Make”

2. Related Work

This section depicts some methods for handling process of handoff with the Machine Learning concepts. Most of the researchers concentrated about the network parameters, Quality of Service and Classification techniques. Many research works are demonstrating the comparative study of various generations of Mobile networks and technologies. Heterogeneous WSN were constructed with fuzzy for implementing handover parameters like Parameters are Signal, Bandwidth, Network coverage, and velocity and power consumption. Here Fuzzy logic was implemented to achieve the good performance [10]

In this previous work, large scale machine learning was implemented by the authors and depicts the use of IoT with supervised learning. They made clusters and patterns for user equipments to train the accuracy of the handoff mechanism. The research output shows that better performance than cutting edge mechanism [11].

2.1 Dataset Parameters in WSN

Signal: Signal is one of the ways of communication function across the Wireless Sensor Environments. This is the major parameters for establishing the networks and it leads Received Signal Strength Indicator (RSSI) for low latency.

Bandwidth: Bandwidth is the amount of data that can be transferred from one point to another within a network in a specific amount of time [12].

Network Coverage Area: The service provider of a network that covers the network.

Power Consumption: In the view of electricity, power should be used in very minimum even though it can be applied in larger areas.

Machine Learning Algorithms: ML plays vital role in current human scenario; it may be applied in all sectors. Here, trained ML algorithms are used for classification and optimization functions.

3. Implementation

In this section, we depict the three levels of implementation levels. First we have to preprocess the Mobile or Sensors handoff parameters with Hadoop framework. Second level; extract the features from the existing network and for obtaining features of ML. Third level, we present the Random Forest Classifier algorithm for constructing the network trees and find the exact handoff result with high performance.

1. Preprocessing.
2. Feature Extraction
3. Random Forest Classification

3.1 Preprocessing

In this phase, mobile device properties like MAC address with its dynamic IP address have been recorded for the smoother operation. We plan to process this work for generic architecture model for all the Wireless sensor networks and Mobile phones which are all applicable. Like **IoT** sensors are emitting the signals sequentially or period time or a time of interval. Now days, IoTs are playing eminent role in the human life different automation process. We have to propose the Hadoop architecture for storing and processing the Handoff operation.

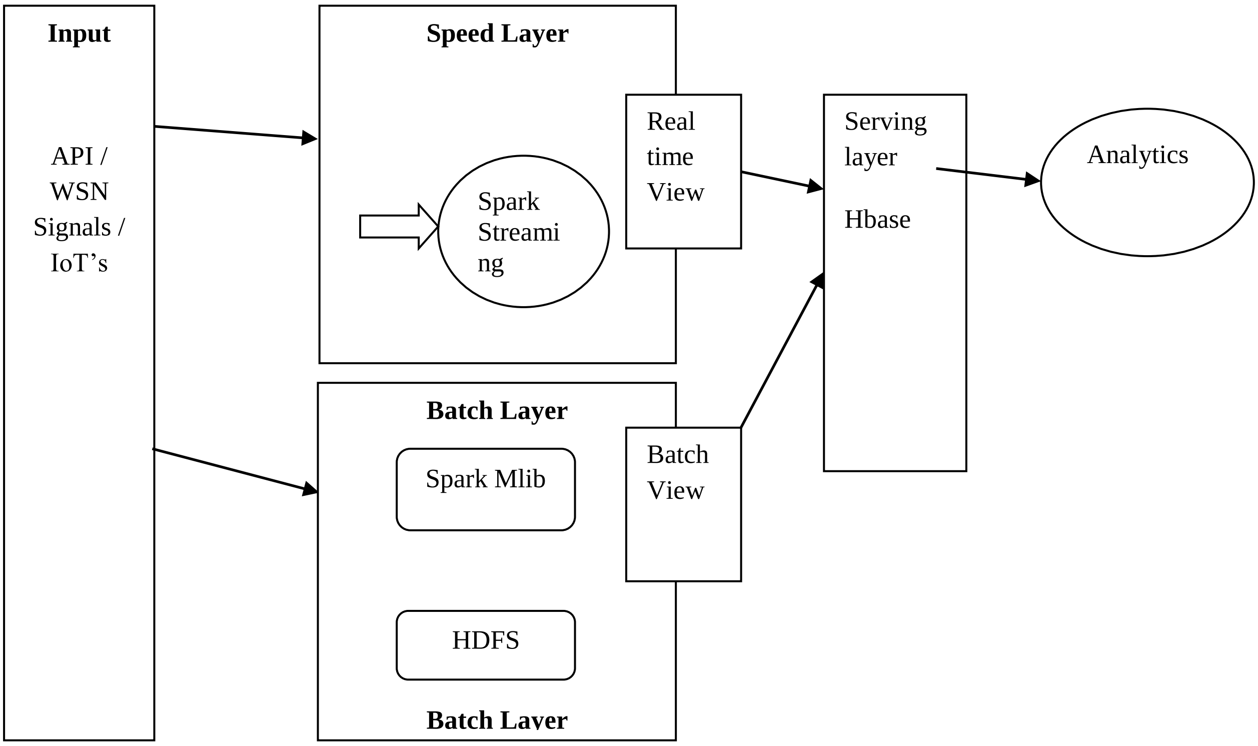


Figure 3 Proposed Architecture

For instance, specified Geographical area of Wireless Network Information is being stored in HBASE in the HADOOP infrastructure. AllJoyn is acted as router for aggregating the IoT or other WN signals. This is used to communicate with cloud infrastructure. It is easy for devices and mobile applications to discover and communicate with each other

3.1.1 Lambda Architecture (LA)

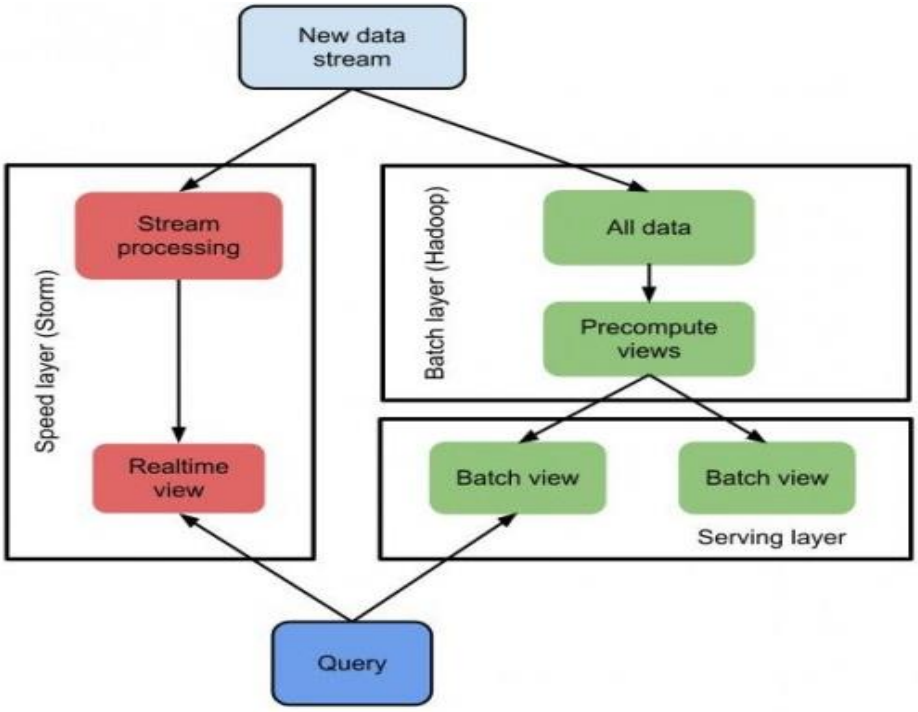


Figure 4 Lambda Architecture

LAMBDA architecture is one of the robust system which emphasis the broad range of workloads with low latency [11]

3.1.2 Functioning of Lambda Layers

There are three layers are supporting to process this open framework and their services are follows

a. Batch Layer
b. Speed Layer
c. Serving Layer

Step 1: First two layers are allowing to enter the data for further evaluating features in the architecture
Step 2: Batch layer is used to manage the main data set and batch-views for prior computing
Step 3: Queries can be analyzed in the section of serving layer; ad-hoc queries and pre-constructed queries are to be analyzed. It also supports dynamic data arrival also.

3.1.3 Implementation

First, we have to get the parameters of the Mobile properties as mentioned earlier [2]. These parameters are to be stored in the Hadoop database via AllJoyn router with MQTT protocol. Our Lambda architecture supports both batch processing and real time processing. For instance, Mobile identification MAC address will be stored in the batch layer and its dynamic IP address will be stored in service layer.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	iPhoneUID	rssi4	rssi5	latitude	longitude	finalLatitude	finalLongitud	horizontalAc	isMoving	txPower	cellID	LAC	MNC	ARFCN	freq_dlink	fre
2	a841f74e620	-69	-69	35.515535	24.027854	35.515535	24.027854	65	0	30	60567	312	1	787	1860.2	
3	a841f74e620	-69	-71	35.515535	24.027854	35.515535	24.027854	65	0	30	60567	312	1	787	1860.2	
4	a841f74e620	-69	-67	35.515535	24.027854	35.515535	24.027854	65	0	30	60567	312	1	787	1860.2	
5	a841f74e620	-81	-81	35.515535	24.027854	35.515535	24.027854	65	0	30	60567	312	1	787	1860.2	
6	a841f74e620	-85	-85	35.515535	24.027854	35.515586	24.027946	65	1	30	60567	312	1	787	1860.2	
7	a841f74e620	-87	-85	35.515586	24.027946	35.515586	24.027946	74.51	0	30	60567	312	1	787	1860.2	
8	a841f74e620	-81	-81	35.515586	24.027946	35.515586	24.027946	74.51	0	30	60562	312	1	787	1860.2	
9	a841f74e620	-83	-83	35.515586	24.027946	35.515586	24.027946	74.51	0	30	60562	312	1	787	1860.2	
10	a841f74e620	-85	-85	35.515586	24.027946	35.515586	24.027946	74.51	0	30	60562	312	1	787	1860.2	
11	a841f74e620	-97	-97	35.515586	24.027946	35.515586	24.027946	74.51	0	30	60562	312	1	787	1860.2	
12	a841f74e620	-97	-95	35.515586	24.027946	35.515586	24.027946	74.51	0	-255	60562	312	1	787	1860.2	
13	a841f74e620	-83	-81	35.515586	24.027946	35.515583	24.02806	74.51	1	-255	60562	312	1	787	1860.2	
14	a841f74e620	-79	-79	35.515583	24.02806	35.515583	24.02806	83.82	0	-255	60562	312	1	787	1860.2	
15	a841f74e620	-83	-83	35.515583	24.02806	35.515484	24.027965	83.82	1	-255	60562	312	1	787	1860.2	
16	a841f74e620	-79	-79	35.515484	24.027965	35.515484	24.027965	71.93	0	-255	60562	312	1	787	1860.2	
17	a841f74e620	-77	-77	35.515484	24.027965	35.515484	24.027965	71.93	0	-255	60562	312	1	787	1860.2	
18	a841f74e620	-77	-77	35.515484	24.027965	35.515484	24.027965	71.93	0	-255	60562	312	1	787	1860.2	
19	a841f74e620	-77	-77	35.515484	24.027965	35.515484	24.027965	71.93	0	-255	60561	312	1	794	1861.6	
20	a841f74e620	-77	-77	35.515484	24.027965	35.515484	24.027965	71.93	0	-255	60561	312	1	794	1861.6	

Figure 5 Handover Parameters.csv

3.1.4 SPARK MLLIB

Pipelining is the automated control process which is incorporates with software version control so we implemented this machine learning framework using SPARK ML learning pipeline. The pipeline consists of three stages which are

- Words are spilt by handoff documents
- Future vector generated by using words
- Learn a prediction model using the feature vectors and labels[7].

Algorithm:

1. Start the process
2. Import the ML features from Spark.Ml
3. Handoff_PARAM (PhoneID, LT,LN,D_Power,mnc,fre_link)
4. Set MaxIter(N)
5. Pass PARAM to fit()
6. Else goto step1
7. Generate Param_Map (Iteration ->10..)
8. If (Hypothesis = YES)
9. Return ACTION

10. End

By using this framework, PARAM is the method which consists of N arguments which already defined by the preprocessing section. We suppose to form the Max tree for getting the optimum value. For Instance PhoneId is one of the parameter, it starts like aX84x114; which is the high prioritize signal. The loop will be run with N parameters and form the Hypothesis Map for further optimization purpose.

3.2 Extracting the Features

Large database are consisting with different features and it is very difficult process for our expecting or maximizing the output scenario. Hence we need to identify spectacular properties from the larger data set. In this part, data sets are to be reduced by the small groups for optimizing the features [7].

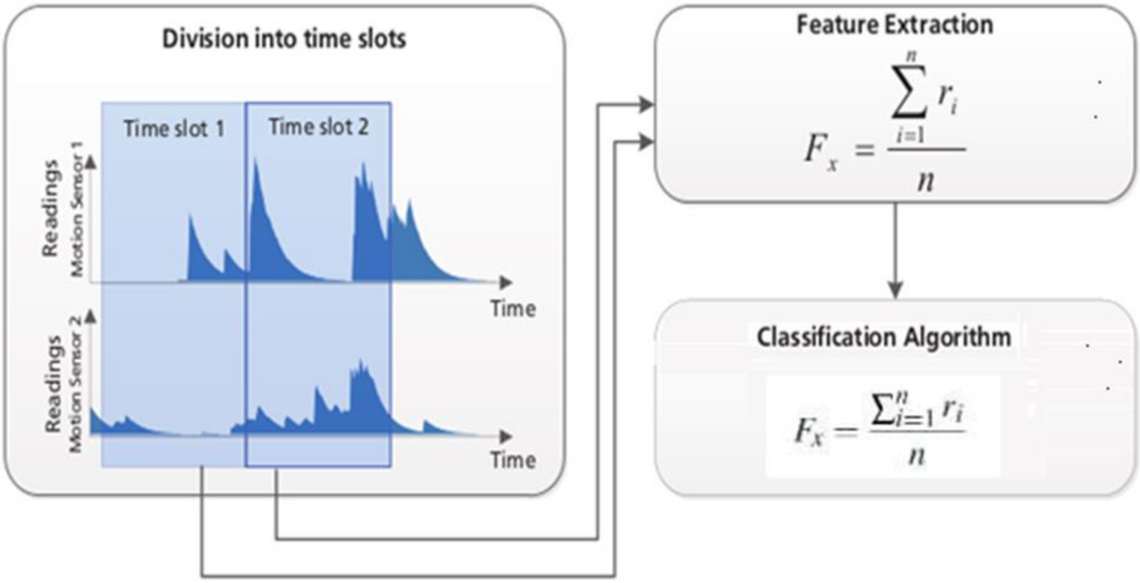


Figure 6 Feature Extraction

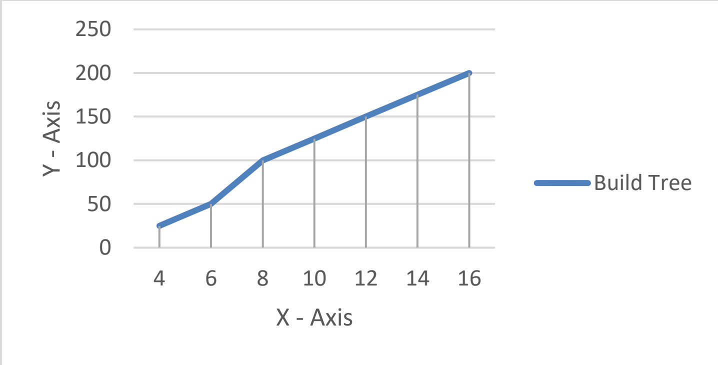
Fx is the identified features for our framework which is processed by sensor-x, in the time of interval how many sensors are entered in the database is identified by n, and reading value is r_i

3.3 Random Forest Classification

Random forest classifies is performing like tree structure with training data set. In this work, it is used for searching and finding the next handover hop without latency. It is also demonstrated to find the successful path and paves it dataset in a right direction. If all the datasets all comes to failure, then it redirected to another path with basic hypothesis. For instance, mobile bandwidth is low and more number of WSNs are to be connected. RS will redirect the datasets which is having higher priority that sensors will be connected and remaining will be formed as non-priority queue.

Spark Mlib enables with random forest classification using WSN features. It implements RS using the decision tree implementation. Feature extraction Algorithm is applied on the WSN data set and data cleaning is performing with Spark M. It accepts training files in libsvm format.

X axis	**Y axis**
Time taken for Tree Searching	Build Tree
4	25
6	50
8	100
10	125
12	150
14	175
16	200



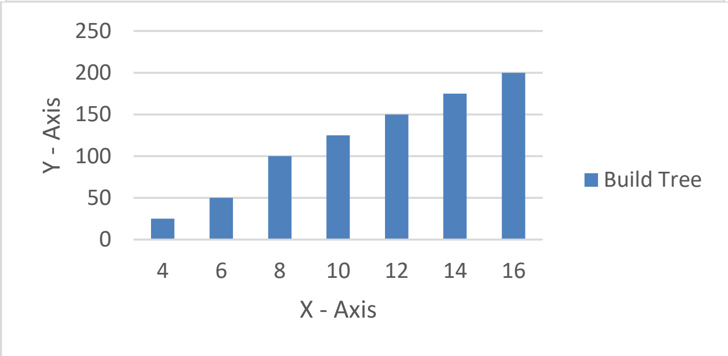


Figure 5 shows the 80 % of real time data and 20 % of unknown f WSN data has been given for training for accuracy of the model built evaluated. The depth of the tree would be 16 level, and the number of tree are constructed is varied from 25 to 200

4. Conclusion

This paper has depicted a generic architecture for WSN handoff using Machine Learning algorithms. This framework is applied for not only Mobile Handoff, both all kind of WSN signals and transmission. The various batches of datasets are processed with in cluster. The performance of Random forest classification has been analyzed. As a future of the work, Voice over Phone (VO), LTE will be analyzed using Apache Spark. Deep Belief Network enables the models and feature extraction, optimization using Convolutional Neural Network (CNN).

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