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FITBIT SURGE BASED ACTIVITY EXTRACTION MECHANISM IN SOCIAL SENSOR NETWORK

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ABSTRACT:

In our day-to-day life, advancements in hardware and software developments have provided a number of new technologies such as the integration of social and sensor networks which have been one of the main objectives of research for various scientists. For example, a small mobile sensor device which is able to collect a variety of information about a human being's body and then generating results in the form of audio and video files has been of a high success nowadays. The other example may be a software application which extracts the information about the current user's location, his/her moves, etc. In this paper, we use the same approach by proposing a mechanism; Fitbit Surge, which collects information from the human body and transmits the results to both their smartphones and external servers. The other algorithm; Activity Clustering Algorithm (CA) which clusters a group of people based on their relevant activities is also used. We then incorporate Quick Recommendation mechanism in our proposed scheme to provide the communication between those groups of people in the cluster while the RoundRobin with Highest Response Ratio Next (RRHRRRN); a load-balancing algorithm at the server-side is finally used for processing the requests. The experimental evaluation of our proposed mechanism using the Omnet++ reveals its effectiveness in term of Overhead, Growth rate, and Efficiency parameters.

Index Terms: Social Network, Sensor Network, Load Balancing, Clustering, FITBIT surge

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I. INTRODUCTION:

Nowadays, integrating the social and sensor networks is one of the main focuses of various researchers as the advancement of technology in terms of new and sophisticated hardware. Software's development is daily and progressively increasing. Social Network is defined as a social structure made up of social actors and a set of dyadic ties between these actors. This network provides a set of methods which analyzes the structure of whole social entities as well as several theories that explains the patterns observed in the structure. To identify the local and global patterns, locate influential entities and examine network dynamics, it uses social network analysis. The applications of social networks are Facebook, Twitter, YouTube, Instagram etc. A sensor network consists of multiple detection stations which are called sensor nodes that are small, lightweight and portable. These nodes are equipped with a transducer, power source, microcomputer and transceiver. Many potential applications are there for sensor networks such as Industrial automation, Automated and Smart homes, Video Surveillance, Traffic Monitoring, Medical device monitoring, etc. These networks work together and provide development in several domains such as Mobile computing, Data mining and Signal Processing [1]. Trust based system which process social network information for information related communications that are modeled it into a trust network [2]. Most online social communities, exhibit complex relationship structures. For avoiding this, we will introduce a model with positive and negative relationship types. This process reduces the significant cost and complexity of network propagation [3].

We use an approach called bio-inspired which determines the group size by researching and simulating primate society to reduce the difficulty in determining group size by researching and simulation process [4]. Implementation of Information and Communication Technologies (ICTs) are important for the deployment of Smart City based on the geographical information tools. This smart city application is the challenging task for the cooperative task such as dynamic environment, timely emergency response and citizen safety measure [5].

Crowdsourcing sensing task is based on the credible interaction between users with the help of the Mobile Crowd Sourcing (MCS) which uses mobile terminals such as smart phones to collect and analyze the information of people and surrounding environment and also analyzes service characteristics and activity patterns [6]. Internet of Things (IoT) delivered constant information from physical objects information through sensors in online. This provides a design employing social networks which facilitates coordination and collaboration among sensor networks [24]. The challenge on social networks is transformation of capturing sensory data from Body Sensor Network (BSN) to social network, it solved by handling both the mobility of Body Sensor Network (BSN) and members in the social networks [25]. Different sensor networks are growing in the real world, because sensors are ubiquitous. Nowadays sensors are inbuilt in smart phones which results in Social Networks of Sensors (SNoS) [26]. Integration of social and sensor networks are proposed as a practical approach for the context-aware data discovery which uses smart phones as proximity sensors [27]. Nowadays, many mobile social networks are working with recommendation system, like travel Recommendation system which gives effective results [28]. Different applications are progressed effectively which are associated with social sensor network. Fig 1 illustrates the combination of social and sensor networks and their applications such as Crowdsourcing, Trust based system, positive negative relation to user, health awareness, activity recognition etc. Many of these applications facing difficulties due to less in security and they are working unaware of user's location.

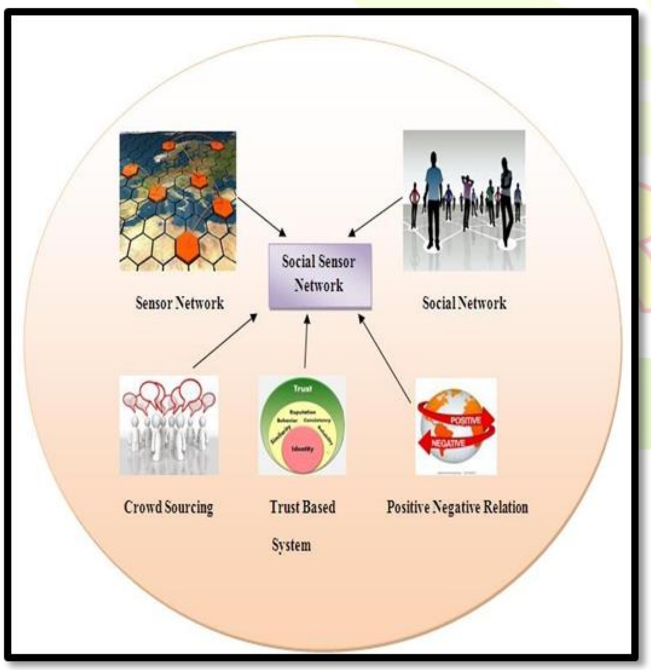

Fig 1: Social Sensor Network

Our scheme extracts lifestyle of the human by using wearable sensor called Fitbit surge which sense the information from human body. The followings are our paper's contributions:

- Sensor collect data from human body and transmit them through mobile app to the mobile phones
- Collect the data from the mobile phones and store them on the server.
- Based on activities, we make clustering process such as:
  - Active time
  - Sleep time
  - Calories
  - Walkup distance
  - Heart Rate

  This clustering process is done by new algorithm called ACA (Activity Clustering Algorithm).

- An effective load balancing algorithm is carried out called Round Robin with Highest Response Ratio Next (RRHRRN) for processing the request in server.
- Communication is carried between the inter cluster and intra cluster based on recommendation system. This system creates a table about the user's information for finding them, when request generates.

The remaining of this paper, Section II describes about the literature review of the paper. In Section III we discuss about the Problem definition. In Section IV we discuss about the overview of proposed work and methods and process carried on to the proposed framework of the paper which includes the Process of Sensor, Clustering and Recommendation System. Section V is the discussion of performance evaluation of our proposed framework. Finally, in Section VI we conclude the paper.

II. LITERATURE SURVEY:

Researchers Ashraf Darwish and Aboul Ella Hassanien stated that, Wireless Sensor Network (WSN) technologies are considered one of the key areas for the healthcare application for improving the quality of life of human beings and they provide future directions of research on wearable and implantable body area network system for monitoring of the patients continuously [7]. Researchers Rami Albatal, Cathal Gurrin , Jiang Zhou, Yang Yang, Denise Carthy, Na Li proposed a framework called SenseSeer which supports customizable analytic services for sensing an human being, and to understand the semantics of life activities. This framework also demonstrates the design principles and three services [8]. In paper [9], author proposed a hybrid and distributed environment which is for collecting data

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from mobile phones and also analyses sensory data that gives insights to user behavior and lifestyles. This technique creates and saves log file repository on cloud for the user. Authors in [10] evaluate an application called CenceMe which represents first system which combines interference of the individual person who are in presence using off-the-shell, sensor-enabled mobile phones that shares information through social network such as Facebook, Twitter, etc.

This application is implemented on Nokia N95 phones. Researchers such as Surender Reddy Yerva, Hoyoung Jeung, and Karl Aberer [11] presented a framework, a travel recommendation system which offers predicted mood information of the people where and when they wishes to travel and this system allows the framework to integrated analysis, extracting weather-dependent people's mood information from social network such as Facebook, Twitter, etc. by blending heterogeneous social and sensor data. The collected data from social network are stored in a cloud serving systems such as Hadoop, HBase and GSN. Researchers Hala ElAarag, David Bauschlicher and Steven Bauschlicher [12] proposed system architecture called Hatter Health Connect which allow Body Sensor Networks (BSN) for efficiently monitor and record the data in the network form the human body, while minimizing the energy expenditure of nodes in the network.

This paper connects the social network with BSN thatcreates a unique ability which allows social interactions to share health related data with other users. Author [13] reports a mechanism for estimating the elderly well-being condition based on usage of home appliances which are connected through several sensor units. This paper describes ZIGBEE based home monitoring system for the elder person daily activities.

In paper [14], author proposed an algorithm called Priority-based Allocation of Time Slots (PATS) that has a fitness parameter which characterizes the health data when a packet arrives. This parameter allows for designing a constant hawk-dove game. Researchers Moshaddique Al Ameen and Kyung-sup K wak studies the social issues in the Wireless Sensor Network (WSN) and they gave the results based on the wearable sensors and non-wearable sensors perspective to the healthcare applications. This study involves threads, attacks, privacy issues and the legal issues [15].

In paper [16], author proposed an application called Friendbook which is a semantic friend recommendation system for the social networks based on the lifestyle of the human beings. This application discovers the lifestyles of users by using the sensor data and measures similarity between the users. It uses a Latent Dirichlet Allocation Algorithm for the extraction of lifestyle and we calculate user's impact for the friend matching graph. Researchers such as Jeff Naruchitparames, Mehmet Hadi Gunes, and Sushil J. Louis proposed an approach to friend recommendation based on the complex network theory and cognitive theory and a Pareto-optimal genetic algorithm in order to provide quality and to determine the individual friendship with others [17].

Authors in [18] proposed a social network based service recommendation system that works with the trust enhancement called as RelevantTrustWalker. Here a trust between users is assessed by the matrix factorization method and to obtain recommendation result extended random walk algorithm is proposed by the author. Researchers such as Mustafa Ilhan Akbas, Matthias R. Brust, Carlos H.C. Ribeiro, and Damla Turgut proposed a framework called FAPEbook with wireless sensor and actor network (WSAN) protocol designed for monitoring the social interaction for the Gorillas which is a complex social network. Here sensors are intended to be attached on the apes which results in forming a mobile network. This protocol used to specify the roles played in the life of gorillas [19]. Author Xuxun Liu explained about the survey of the Clustering Routing Protocol in wireless sensor network [20]. Author Imran Qureshi, presented the survey of CPU scheduling algorithms for process the jobs easier [21].

In paper [22], author focused on load balancing algorithm called Round Robin with Higher Response Ratio Next for server accessing. Researchers such as Sambolec. I, Rukavina. I, Podobnik.V, proposed a framework called RecoMMobile which is a spatiotemporal recommender system for the smart phone users. Popular group of context-aware services are location based process and intelligent services which combines user location and other location for the value added services [29].

In the paper [30], author provided rich data for many consumer applications based on integrating sensor networks and social networks. This involves multi-tier architecture which separates data gathering, representation, aggregation and analysis which results in semantically meaningful knowledge. Researchers such as Feng Xia, Nana Yaw Asabere, Ahmedin Mohammed Ahmed, Jing Li, and Xiangjie Kong surveyed the importance of the mobile multimedia recommendation system that overcomes the challenges of mobile devices such as storage limitations which leads to mobile multimedia overload to users. Here Mobile social Learning, context-aware services and mobile event guide gives the information to the recommendation system [31].

Researchers like Aaron Beach Mike Gartrell, Xinyu Xing, Richard Han, Qin Lv, Shivakant Mishra, Karim Seada proposes socialFusion that systematically integrates the diverse mobile, social, and the sensing input streams that effectively results in context-aware output action [32].

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III. PROBLEM DEFINITION:

Nowadays, many sensors have begun to infiltrate lives of every people. These sensors provide information like car condition to its owner, enabling smart buildings, etc. On the other hand social networks, another emerging trend allows insights in the communication links between human beings. Social Sensor Network is the integration of social network and sensor network which is processed through the internet. Several applications on social sensor network focuses mainly on the healthcare based process. Very few applications are focusing on lifestyle extraction with the help of smart phones; still they do not provide efficient outcomes with parameters like recommendations, clustering. To overcome these drawbacks, we propose a new mechanism that allows user for the better recommendation services between the users.

In our proposed concept we consider the parameters such as Growth Rate, Accuracy, Overhead, and Reachability. These are parameters which must be considered in social sensor network because the input values are collected from wearable sensor called Fitbit surge. This sensor transforms the collected data to the mobile app followed by the external server. Based on the activities of humans, we make the clusters. Accuracy is considered for performing the efficient process of clustering. The details of clusters are maintained and user's requests are processed by the server which performs load balancing algorithm. The parameter Growth Rate (GR) analyses the working of our proposed work. This is measured by the increasing number of users. Reachability analyses the successful reaching of information to the destination users.

IV. PROPOSED WORK:

4.1. OVERVIEW:

Our proposed work mainly focuses on the Social Sensor Network (SSN). In this process, we get the information of daily activities of human beings by using fitbit surge sensor that is associated with social networks for acquiring services and achieving good results of the newly developed social sensor application.

Our new mechanism is used to develop lifestyle extraction like daily activities such as number of steps they walk, active time, sleeping time, how many calories are there in their body and user location.

This mechanism provides the information like heart rate, number of steps they walk, sleeping time, etc. and also allows information sharing with their contacts. Our mechanism includes recommendation system, clustering concepts. To perform those operations in our proposed work, we perform new algorithms in order to achieve good results. The overall mechanism is described in Fig2.

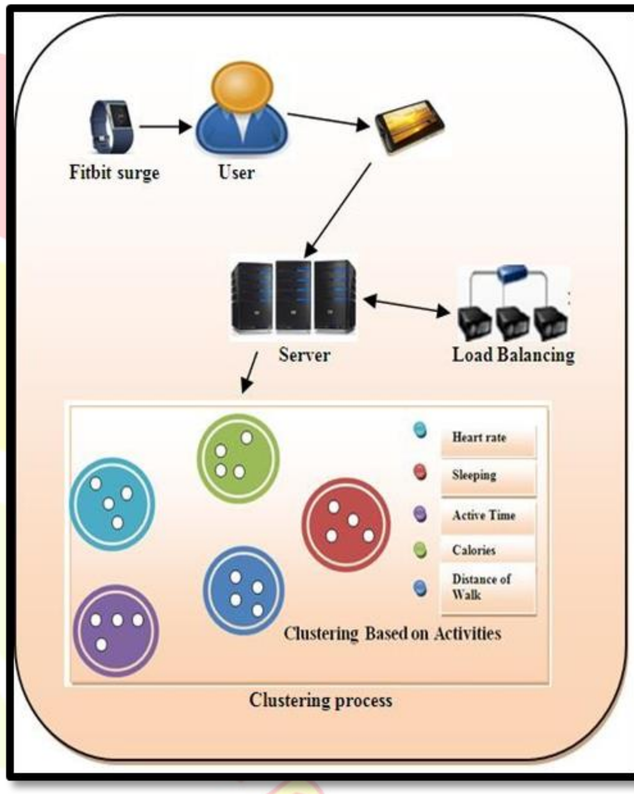

Fig 2: Overall Proposed Mechanism

4.2. PROCESS OF SENSOR:

Sensing is an initial process in our mechanism. Lifestyle activity extraction based sensor is used for our mechanism and this sensor should be wearable. Due to fast world, people eats unhealthy foods, so they are unable to maintain their body weight. Many people wish to reduce their body weight and live a healthy life. For this purpose they wish to do physical exercise, eat a healthy food, maintaining their diet, doing yoga exercises etc. We use Fitbit surge wearable sensor for our mechanism which satisfies the above constraints. The fitbit surge sensor includes various sensors like Pure Pulse LED light, Accelerometer, and motion sensor. The Fitbit surge looks like watch that available in three types of sizes they are 5.5 and 6.7 inches, 6.3 and 7.9 inches, and finally 7.8 and 9.1 inches. This sensor tracks activities like steps, heart rate, distance, calories burned; floors climbed, and simplified heart rate zones. This sensor will track exercises of the person such as walking, hiking, running and biking by automatically activating the GPS.

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This sensor is water resistant. It can stand up in rain and splash, but it can be removed before swimming and showering. In advance this sensor can monitor sleeping time and heart rate of the person. Heart rate is monitored based on the pure Pulse LED light which reflects onto the skin to detect blood volume changes, to measure heart rate automatically and continuously, the sensor applies finely tuned algorithms. Sleeping time is monitored by the motion sensor. The charge of the battery is long last upto 10 hours that uses GPS. These are the sensors that are included in the Fitbit surge. In our process, sensor collects data from human body and transmits them through mobile app called Fitbit app to the mobile phones. Every sensor collects data that are transformed to the server and we move the process to the next stage of our framework.

4.3. CLUSTERING:

Clustering is defined as the process of grouping a number of similar things or objects. In our framework, clustering is the main part in the social sensor network. In this process, cluster is based on the sensory information i.e. activities of the human beings. We cluster the people based on five activities, they are

- Active time
- Sleep time
- Calories
- Walkup distance
- Heart Rate

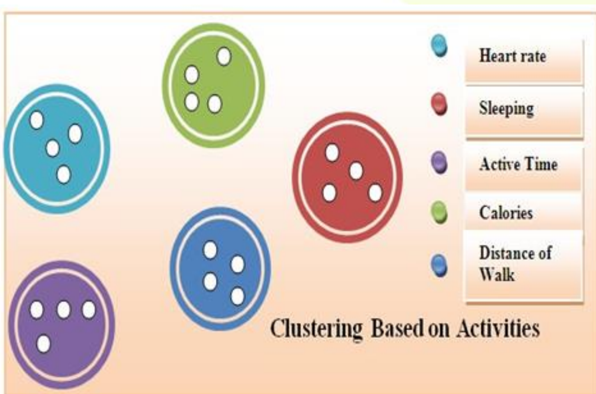

Fig 4: Clustering Based on Activities

These are the major activities collected in Fitbit surge sensor. Here the Heart rate is monitored by pure Pulse LED Light and the sleeping time is monitored by motion sensor. These are all covered by the Fitbit surge. These activities are grouped individually. The accelerometer sensor allows knowing the walkup distance of the people. Calories and active time of the peoples are clustered individually. This sensor information is collected on the mobile application called Fitbit App and it is forwarded to the external server. The people who are using the Fitbit sensors are connected in the Fitbit application and can share the messages and daily activities.

These processes are done by our clustering algorithm called Activity Clustering Algorithm (ACA).
The Fig 3 shows the pseudo code of this process.

Pseudo code: Activity Clustering Algorithm

Inputs:

$U_i \rightarrow \{U_1, U_2, U_3 \dots U_n\}$,
$S_i \rightarrow \{S_1, S_2, S_3, S_4\}$ & C_i
$\rightarrow \{C_1, C_2, C_3, C_4, C_5\}$

Initialization:

Begin
i) $U_i \rightarrow S_1$
$U_i \rightarrow C_5$
ii) $U_i \rightarrow S_2$
$U_i \rightarrow C_3$
iii) $U_i \rightarrow S_3$
$U_i \rightarrow C_1$
iv) $U_i \rightarrow S_4$
$U_i \rightarrow C_2$ and C_4
End

Fig 3: Activity Clustering Algorithm

The above pseudo code describes the clustering process of our proposed mechanism. Here U_1, U_2, $U_3 \dots$ represents the number of users in the system. S_1, S_2, S_3, S_4 represents the number of sensors used in the process. And finally C_1, C_2, C_3, C_4, C_5 represents the number of clusters or activities of the peoples. S_1 is the accelerometer for walkup distance C_5, S_2 is the pure pulse LED Light for heart rate C_3, S_3 is the motion sensor for C_1, S_4 is the Fitbit surge that identifies the active time C_2 and Calories C_4. The algorithm begins with all of those sensors that start at the same time. Here accelerometer (S_1) gives information to the C_5, pure pulse LED (S_2) gives information to the C_3, Fitbit (S_4) gives information to the C_2 and C_4. Here Motion Sensor (S_3) gives information to the C_1. The following diagram represents the clustering process. Fig 4 shows the diagrammatic Clustering process.

4.4. RECOMMENDATION SYSTEM:

Recommendation is defined as a suggestion or proposal for the best action which is received from the authorized persons. The main goal of a Recommendation System is to provide meaningful recommendation to the group of users for individual products where people are interested. Recommender systems are work

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carried out by getting rating from the large number of users. Our proposed concept needs help from the recommendation system. Because each and every person participated in our mechanism, so they need to communicate with all members in the cluster for the purpose of the daily activities. In our process, we introduce a Quick Recommendation Algorithm. Here users are grouped according to their activities and they pass their request to the server.

Server has two indices for identifying the user requested person which can check the details of the user. The server used two indices such as Recommendation Index (R_{Index}) for request and Inverse Recommendation Index (IR_{Index}) for response. This provides suggestions to accordingly. In this process, Recommendation Index has the following:

- Username
- User location
- Cluster Id i.e. Activities of the ser.

Inverse Recommendation Index has the following:

- Username
- Cluster Id i.e. Activities of the user.

Here the user location specified by the GPS tracking for the privacy purpose. The Inverse Recommendation Index is used for quick response for the user which is done by external server. These are useful for requesting a user for the message passing. This Quick Recommendation Algorithm will provide proper and exact response to the users. Fig 5 describes the following recommendation algorithm. Table 1 represents the index of Recommendation Index and Table 2 represents the index of Inverse Recommendation Index.

TABLE 1: RECOMMENDATION INDEX

USER	CLUSTER ID	LOCATION
Robin	Sleeping Time	Chennai
Aakash	Heart Rate	Bangalore
Mary	Active time	Trichy

TABLE 2: INVERSE RECOMMENDATION INDEX

CLUSTER ID	USER
Sleeping Time	Robin
Heart Rate	Aakash
Active time	Mary

The below algorithm describes our Quick Recommendation system. Here U_1, U_2, U_3… represents the number of users in the systems, R_{Index} is the Recommendation Index, IR_{Index} is the Inverse Recommendation Index, Req is the request of the users, Res is the response of the user and C_1, C_2, C_3, C_4, C_5 represents the number of cluster in the process. When a user sends a request, server checks the R_{Index}, if it true then the request is passed to the specified user otherwise the request will be discarded. On the other hand, user sends response; the server checks IR_{Index} and passes it to the specified user. According to the response the user ratings are generated which is visible to all other users. Fig 6 shows the diagrammatic representation of the Recommendation System.

Pseudo code: Quick Recommendation Algorithm

Inputs:

$U_i \rightarrow \{U_1, U_2, U_3 \ldots U_n\}$, R_{Index}, IR_{Index}
Req $\rightarrow \{U_i, U_{Location}, C_i$, Other U_i, Other $U_{Location}\}$,
Res $\rightarrow \{C_i, U_i, U_{Location}\}$ C_i
$\rightarrow \{C_1, C_2, C_3, C_4, C_5\}$,

Initialization:

```
Begin
    Enter Ui
    Pass  Req
    If (RIndex )
        {
         If (IRIndex)
             Pass Res
         Else
             Error
         End if
        }
    Else
        Error
    End if
End
```

Fig 5: Quick Recommendation Algorithm

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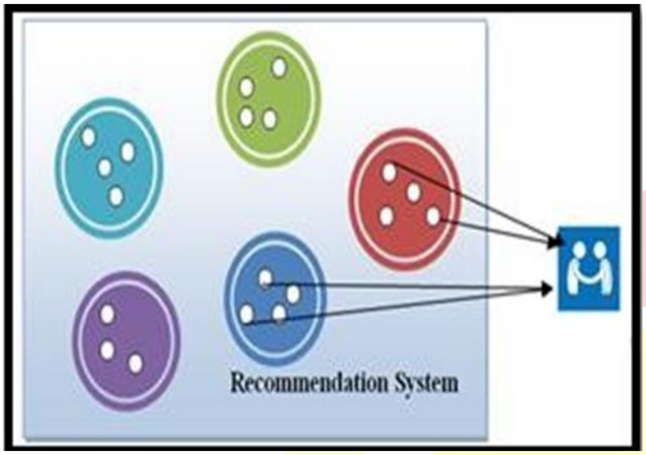

Fig 6: Recommendation System

In our process, external server process the request based on a new load balancing algorithm called Round Robin with Highest Response Ratio Next (RRHRRN). This Algorithm is used for real time systems that solve drawbacks in the Round Robin scheduling process such as larger context switches, larger waiting time and turnaround time. Our process is similar to Round Robin Process where processes are added to end of ready queue based on the arrival time. Here we calculate Higher Response Ratio (HRR) for every process which is easy to select process from ready queue. The Response Ratio is calculated by,

$$\text{Response Ratio} = \frac{\text{Waiting time} + \text{Service Time}}{\text{Service Time}}$$

Initially, the processes with higher response ratio are taken to the process queue and allowed to run in CPU with a time quantum. After the initial process, remaining burst time is calculated for the purpose of finding the dynamic time quantum. Fill the ready queue according to the arrival time and process the request. Fig 7 shows the flowchart of the RRHRRN algorithm and Fig 8 describes the RRHRRN Load balancing algorithm.

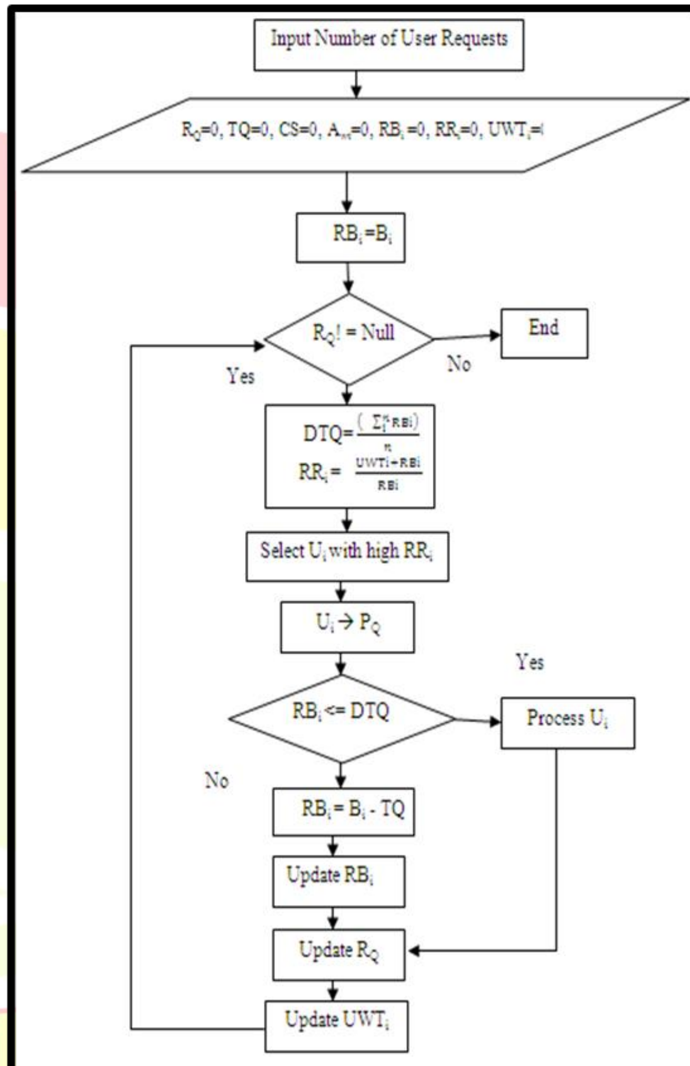

Fig 7: Flowchart for Round Robin with Highest Response Ratio Next Algorithm

Our pseudo code is explained as follows: R_Q represents the ready queue, P_Q represents the process queue, U_1, U_2, U_3… represents the number of requests from the user, A_1, A_2, A_3… represents the number of arrival time of the user requests, B_1, B_2, B_3… represents the number of burst time of user requests, RB is the remaining burst time of specified process, RR is the response ratio of specified process, UWT is the updated waiting time of process. DTQ is the dynamic time quantum which is calculated by mean of remaining burst time of processes.

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Pseudo code: Round Robin with Highest Response Ratio Next Algorithm

Inputs:

```
R_Q, P_Q U_i → {U_1, U_2, U_3… U_n},
A → {A_1, A_2, A_3… A_n},
B_i → {B_1, B_2, B_3… B_n},
```

Initialization:

```
R_Q=0, TQ=0, CS=0, A_wt=0
Begin
    For i=1 to n
    RB_i =0, RR_i=0, UWT_i=0
    RB_i =B_i
    Enter U_i into R_Q
    while (R_Q !=Null)
        DTQ= (Σ_i^n RBi) / n
        RRi= (UWTi +RBi) / RBi
        For i=1 to n
          Sort U_i with RR_i
          Select U_i with RR_i
        U_i → P_Q
        If (RB_i <= DTQ)
            Process U_i
            Remove U_i from R_Q
        Else
            RB_i = B_i - TQ
            Update RB_i
        End if
        Update R_Q
        For i=1 to n
           Update UWT_i
           Goto 4
    End while
End
```

Fig 8: Round Robin with Highest Response Ratio Next Algorithm

Initially, user requests are allowed to fill the ready queue. If ready queue (R_Q) is filled, Dynamic Time Quantum (DTQ) and Response Ration (RR) are calculated for each and every process. Then the user request is selected according to the higher response ratio which is allowed in the process queue (P_Q). The user requests are processed in the server according to the Dynamic Time Quantum. If DTQ expires, when the process is not completed then remaining burst time is calculated and their weighting time is updated otherwise the next request in the ready queue is allowed to process in the server. The user requests are processed in the server until the ready queue gets null.

V. PERFORMANCE EVALUATION:

In this section, we compare our proposed mechanism with other previous techniques. Techniques, we used are different but parameters taken by the proposed system and previous system are same. In our mechanism, we have the parameters such as accuracy for clustering, overhead for Recommendation system, Growth rate, and efficiency. Here, previous system algorithm for Clustering is K-medoids Clustering Algorithm and Recommendation system is carried out based on Friendbook. To extend of all those previous algorithm and techniques could be used to identify performance of our proposed mechanism in social sensor networks. Working process of these previous algorithms is described as follows:

- **K-Medoids:** The process of K-medoids Algorithm runs like K-means Algorithm and checks various methods for selecting initial methods. It calculates the distance matrix once and uses it for finding new medoids at every recursive step. This gives accuracy less for every cluster. So we need to increase the accuracy of every cluster.
- **Friendbook:** This Friendbook application applies recommendation scores for the user's request for generating accurate rating but this result in increase of the computational overhead. This can be applied for the large scale systems.

5.1. SIMULATION RESULTS:

We conduct our experiments on the OMNeT++ simulation framework. This simulation tool should help us to perform proposed ISCRHF framework with new algorithms. OMNeT++ simulation was conducted with some considering parameters are shown in Table 2.

For conducting our experiments 50 nodes can be used. Each nodes are in mobility in nature and it can be move from random way from (1 to 25) m/s. Simulation should be conducted in the area of 1000 * 1000m. To perform traffic management in social sensor network we have to use Content Bit Rate (CBR) at a time of packet transmission. Usually, transmission range is defined by 200 m. Here traffic source generation upto 512 bytes data packets.

Simulation consists of IEEE 802.11 MAC protocol are uniformly distributed. Nodes presented in our simulation must moves depend upon random waypoint mobility model which can be created and executed by OMNET++ simulation framework. Speed of the mobility nodes are 25 m/s. Actual raw data of each and every nodes was 2Mb/s. Table 3 clearly have the details of parameters involved in this simulation in an appropriate manner.

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5.2 Performance Metrics:

We consider some of the metrics which are to be conducted for experiments on Omnet++ Simulation framework that between existing system and proposed system. There are some performances parameters which are

- Accuracy
- Overhead

The above parameters are clearly explained and plotted with its graphical representation in next section.

5.3 Comparative Analysis:

We conduct the experiments of our proposed system work with existing system algorithms when concentrating variance of each parameter presented in performance metrics as follows. Comparative analysis can be done with the previous algorithms.

Table 4 represents the accuracy; Table 5 shows the results in overhead.

Table 3: Structure of OMNeT++ Simulation

Parameters	Values
Number of nodes	50
Mac type	Mac/802-11
Channel	Wireless Channel
Interface type	Phy/Wireless Phy
Transmission Range	200m
Packet Size	512 byte
Transmission Rate	5 packets/sec
Nodes Speed	25 m/s
Map Size	1000 x 1000 m
Movement Model	Random
Traffic Model	Constant Bit Rate (CBR

Table 4: Performance of Accuracy

Algorithms	Accuracy
K-Medoids	92%
ACA	95%

Table 5: Performance of Overhead

Recommendation System Algorithm	Overhead
Friend Recommendation Algorithm	O(n)
Quick Recommendation Algorithm	O(n-1)

5.3.1. Accuracy:

The accuracy is defined as the degree to which the result of a measurement, calculation or specification conforms to the correct value or a standard. It is calculated by

$$\text{Accuracy} = \frac{2(AD-BC)}{(A+B)(B+D)+(A+C)(C+D)}$$

Here,

- A→ Number of pairs which are in the same cluster of compared clustering solution for pairs of objects in certain cluster of correct clustering solution.
- B → Number of pairs which are not in the same cluster of compared clustering solution for pairs of objects in certain cluster of correct clustering solution.
- C → Number of pairs which are not in the same cluster of accurate clustering solution for pairs of objects in certain cluster of compared clustering solution.
- D → Number of pairs which are not in the identical cluster of both accurate clustering solution and compared clustering solution.

Fig 9 represents the accuracy of comparison of existing system and proposed system.

5.3.2. Overhead:

The term overhead is defined as the combination of excess or indirect computation time, memory, bandwidth, or other resources which results in acquiring the particular goal. Big O Notation is generally specified by the algorithmic complexity. The algorithmic efficiency is a combination of complexity and overhead. Fig 10 represents the overhead of comparison of existing system and proposed system.

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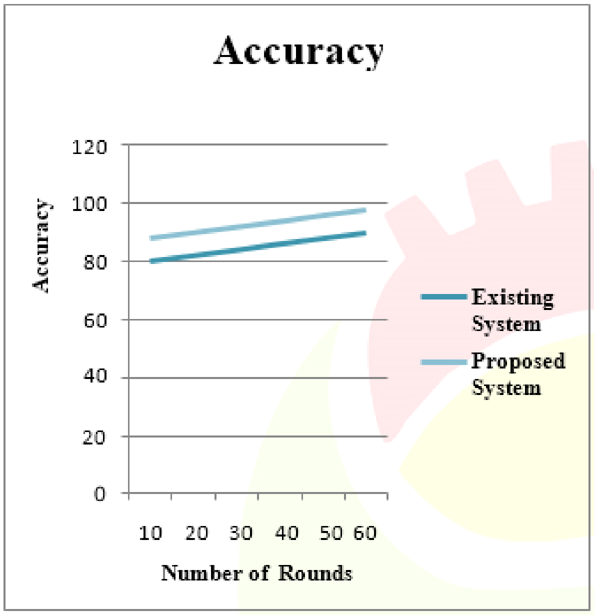

Fig 9: Performance of Accuracy based on Number of Rounds

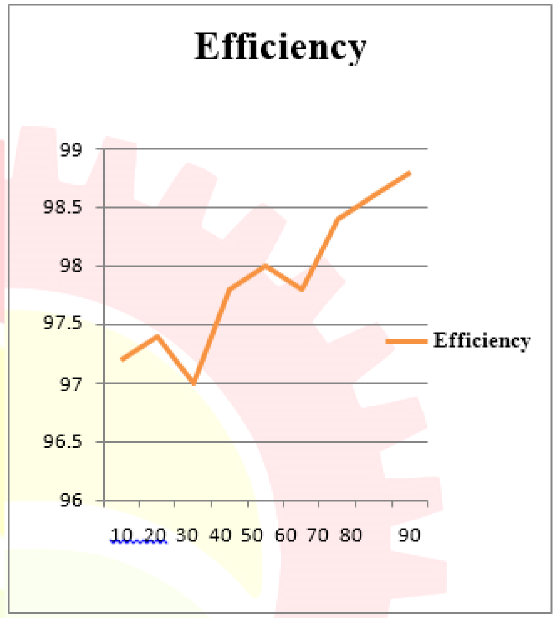

Fig 11: Performance of Efficiency in our Proposed System

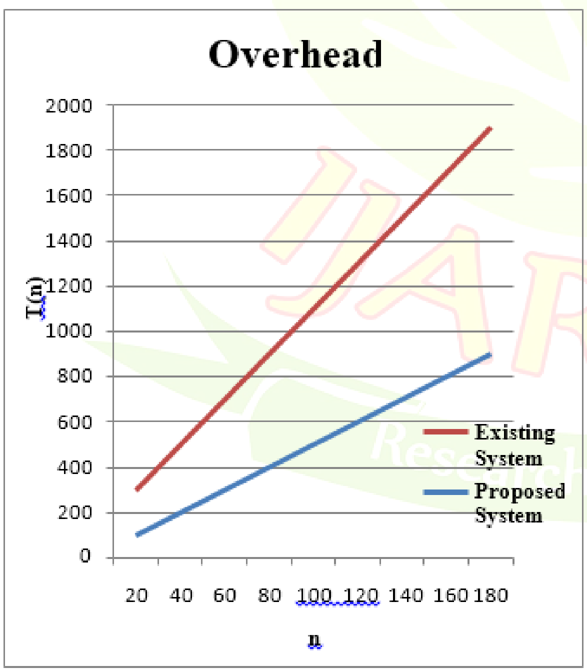

Fig 10: Performance of Overhead based on Number of Recommendations

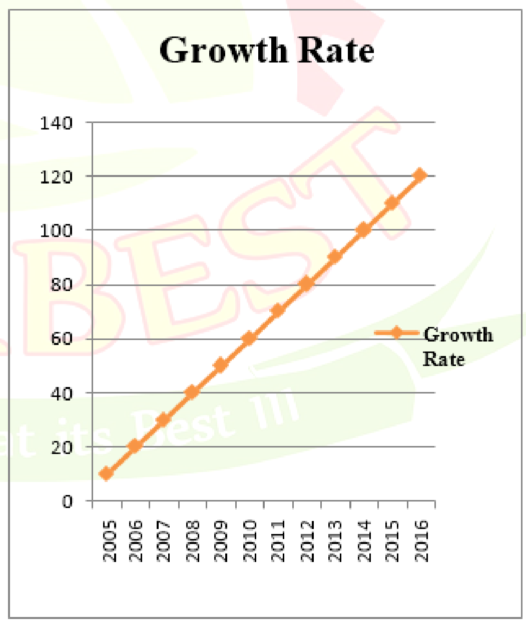

Fig 12: Performance of Growth Rate in our proposed system

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VI. CONCLUSION:

A combination of Social network and sensor network is called ad Social Sensor Networks which have a working nature of both networks. Efficiency is the most important factor in social sensor network because working together process must provide efficient results based on our proposed framework. In our paper, effective clustering algorithm with higher accuracy and recommendation system with lower overhead are discussed in our previous section. Lifestyle extraction of a human being is a challenging process in social sensor network. This process extracts life style with the help of wearable sensor called Fitbit Surge. In order to achieve better results in our proposed mechanism, we developed new algorithms such as Activity Clustering Algorithm, Quick Recommendation Algorithm and load balancing algorithm. In our proposed system, we have to analyze and plot growth rate of our mechanism. Then we have to find the efficiency of our proposed mechanism. Our proposed mechanism is compared with the existing system base on parameters we have taken such as Accuracy, Overhead. Here, above mentioned parameters should perform the process of clustering, recommendation systems. The clusters of our mechanism are done based on activities of human being with wearable sensor called Fitbit Surge. This sensor has inbuilt motion sensor, pure pulse LED light, Accelerometer. According to activities we make five clusters. After clustering, we perform recommendation process in an effective manner to get a response. The server process these request and response in a faster manner based on load balancing algorithm. The user ratings are generated according to the response from destination user. This rating allows human to think about this fitbit sensors and allows them to use for the entire life. Efficiency of our process is evaluated by the overall performance of clustering and recommendation algorithms. Our proposed mechanism provides large number of suggestions through the social networks. Thus our proposed system should provide efficient and effective results in the social sensor networks.

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