A Hybrid Approach of Push and Pull along with VCS to Search in Internet of Thing

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Abstract-as there is an increase in WSN applications, we now have smart devices everywhere. We are now surrounded with sensor objects; Internet of Things is among the highlights in today's Internet era. Searching in an environment where user wants to operate an object remotely or locally is challenging. Traditional search techniques of web possess a challenge as it is built on static documents as well as sensor reading possesses very short life span and real world entities are highly dynamic which means that it won't work with IoT. In this paper we present an idea of using Virtual Coordinate System (VCS) which uses a hybrid approach of push and pull method for searching using IoT. VCS approach has been used in peer-to-peer networks. The proposed mechanism is energy efficient and uses features like memory, computation cost to find optimal result as per as users requirement.

Keywords-Searching, Internet of Things(IoT),Virtual Coordinate Systems, Wireless Sensor Networks.

I. INTRODUCTION

Internet connects millions of people across the globe. In a nutshell Internet of Things is aimed at making our daily life more sophisticated and flexible. Internet of Things is a concept that includes people along with a network of smarter objects. It aims at connecting any object to the Internet and other connecting devices. Each of these objects consists of a sensor of a particular type which collects the data from the surrounding environment and it will either pass the data or do some processing on them. Some of the interesting applications of IoT include checking of water level of your plants remotely or WEMO which allows us to control electronic applications at home using our smart phones. Smart cities are an upcoming concept in IoT. The future that was only just imaginable till now it not far from becoming a reality.

In 2008, the number of things connected to the Internet exceeded the number of people on the earth. But by 2020, there will be approximately 50 billon things connected to the Internet. This plots the Internet of Things into a spotlight in the coming future.

The search space in IoT is much higher than that of web as we have to search through sensor reading and other generated data, but in web only focuses on user generated data. For example if a user has misplaced his wallet in the house and if he wants to search for it then some searching mechanism is needed we have one option to equip each object with a GPS sensor however these sensors have low power supply also they much be cheaply available which is not the case in GPS thus making it a non feasible solution.

There is some implementation for searching in real world like the snoogle or MAX but all of these have some drawbacks as snoogle uses centralized approach which makes it difficult for scalability this leads to distributed approach of MAX but it is followed by a drawback of the queries being costly as it has to be sent to each tag.

VCS is mainly used to find the nearest node to get any services from peer node ie.P2P architecture. Virtual Coordinate System in our proposed technique is used to find dealys, latencies and services of the sensor in the real world whereas as a hybrid approach of push and pull is used to find objects that can be either static or dynamic in a given localised environment. Unlike earlier approach that was proposed, our approach is decentralised and takes various other parameters into consideration.

II. RECENT WORK

This section covers the background theories that are useful for the development of this field. It can be classified as following:

2.1 Object Search

It indicates of finding the object i.e. where exactly the object is placed

A. Snoogle

It is the process of getting information with the help of sensor networks. Real –world objects is connected with sensor nodes that support and moves the textual information of particular objects. These objects will be in the form of keywords. Snoogle has 3 elements object sensors, index points and key index point. These are the super node that will be in charge of IPs.

The object sensor can be undesirable way or it is able to move freely. This depends on the movement of the real world object.

Using the same radio frequency, snoogle needs all object sensors to hare or exchange information

An ***Index point*** is connected with a physical location. IP is a constant sensor device. The main duties of IP are to collect and maintain the data from the object sensors. This will be arranged according to their range. The advantage of IPs are battery powered, they make use of microcontroller, radio module and a huge quantity of flash memory.

The ***key index point*** has responsible of collecting of data from various IPs. The key IP is beginner to access the static power source, powerful processing capacity and hold large amount of storage such as Smartphone or a PDA. Using smart portable devices, snoogle user seek to answer the various questions .End user provides keywords based on whether he/she is focusing for. Depending on these keywords snoogle searches for a particular object sensor that will match those keywords. Two kinds of questions will be performed by user i.e. local or distributed.

A local query carries out search under the region of particular IP. This performance is done when user knows the actual location of the object to be searched. In distributed query, a comprehensive search will be used. Here search will begin from keyIP. In snoogle, ranking algorithm will be applied to user. It also presents top-k results to user.

The constraints of this approach are: it supports searching of constant data. In object sensor whenever the data is changed, the database at IP and keyIP must be updated. This queries the scalability of the approach.

This approach is consolidated to keyIP. In global search, large number of small messages will be transferred. System architecture is shown in Figure1.

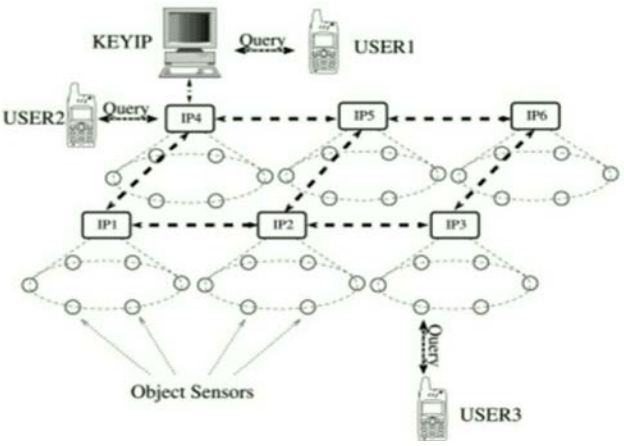

Figure 1: Snoogle Architecture

B. MAX

This is the human centric search engines that make use of human participation to filter search results and assist users in clarifying the search request. This is divided in to two divisions i.e. clustering and categorizing in to hierarchy.MAX approach is used for finding real world objects .It supplies location to humans that will be natural. It assumes that physical objects such as cloths, documents, keys that are attached to small devices. These devices will be having few processing and communication capacities. We make use of privacy concerns tags i.e. public or private. Public tags can be searched by everyone and private tags are searchable by owner. Max makes use of hierarchical structure. Here objects in each level have more mobility compared to higher level.

Base station: It is considered to be the highest hierarchy level. It represents the position of something that cannot be moved e.g. room. It also reserves the description of this locality e.g. guest room. If the size of the room is huge there can be one or more base-stations per locality. These base stations will be used as mediator that will be connected between wired backbone network and wireless tags. These base stations consist of significant memory and it also has the capability of processing.

Sub-station: It is the next level of hierarchy. It determines the object that will be constant and change the positions infrequently. It is powered by battery. It has the few number of processing and communication capacities.

Tags: It is considered to be the lowest level of the hierarchy. It is attached to the objects that will be moved free example cloths. It also stores the description of object to which it is attached. These tags are very small and it has the less cost. These tags are small or may not have static power supply. These tags must be labeled so that it helps the user to find a particular object.

Security agent: It is considered as software agents who will be occupied at the base stations. Before they are allowed to question in the locality covered by the base station, the user has to be verified first. MAX uses pull based approach for the purpose of resolving the queries. User must note the base station that is used to query along with the keywords. Once the query base-station has been received, the query has to be broadcasted to all its substations and these base-stations will be further broadcasted.

Tags are responsible for counting the keywords represented in the query that will match to its own textual description. Substation will pull these counts and will travel to its base station. MAX server and also the user collect the description of top k tags that will be returned by the base-station. The drawbacks of pull based approach are that it supports mobility. Another important drawback is that queries are too costly. MAX aims that every single sub-station and tags receives the queries which causes the MAX as inappropriate for global networks. System architecture is shown in Figure2.

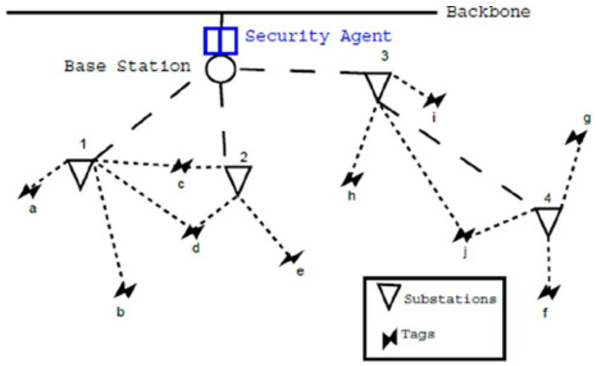

Figure 2: MAX Architecture

2.2 Place Search

It specifies the location of an object. For example we have kept some things on the desk like pen, bag, books etc.It seeks answer to the question what are all things kept in the desk. Example of place search is Dyser.

Dyser

The main work of Dyser it keeps on checking if the device is applicable or not

The architecture of Dyser supports both functionality and parallelism specialization. Through dynamically specialization, there will be frequent executing regions. By applying parallelisms, Dyser provides functional efficiency. The main implementation of designing Dyser is that programs will be executed in phases. Among all the phases only few phases contribute to most of the program's time execution Dyser creates specialized data paths for only frequent executed regions.

III. PROPOSED TECHNIQUE

In this approach we are trying to minimize the issues caused by previously proposed work. Instead of using centralized approach or IP based approach like snoogle, we are using VCS for discovery process. This VCS approach has been used in wired P2P networks for finding the nearest tag which provides the services that has been requested. Along with that we are proposing hybrid approach which consists of both push and pull approach. In our approach we assign each tag with several attribute like memory, energy level of a target which are combined together to generate the services that has been requested by the user. After this we take real time update into consideration which consist of push and pull approach and then do some processing to display the result as per as users preference.

3.1 Parameters

- *Shortest distance:*

This is used find the shortest physically present service provider as requested by the user as and when the user request for it in IoT.

- *Energy level of a tag:*

As wireless networks is equipped with small power supply, energy level highlights as an important parameter thus in case if we are provided with two services which has same distance, communication , memory and computation cost, the tag with highest energy level is given first preference.

- *Communication cost*

Consider a case when the service provider has sufficient memory, good energy level, and higher transmission capacity but is at far distance from the one which requires service then communication cost will be high and that will result in degradation of overall performance. Thus taking into consideration of communication cost in discovery process improves overall performance.

- *Computation cost:*

Computation cost is taken into consideration as there can be some service providers that can have higher resources compared to other service providers and they can complete their task in much lesser time. So in that case tag priority is given to that tag that requires higher computation.

- *Memory*

It is taken into account as the amount of memory available is limited in each tag.

- *Tag status*

It is used to find the current status of the tag. In case tag A is serving two to three clients and tag B is free then tag B is given priority even though its computational power, memory and other resources might be less than that of A.

- *Bandwidth*

As a tag and the service provider need to communicate with one another their transmission capacity should be less otherwise there will be communication delay.

- *Latency*

A latency between two communicating tag should be as small as possible as IoT is a real time approach.

3.2 System Architecture

Proposed system architecture is shown in Figure 3. Here each tag has seven different parameters and the link between each tag consists of two parameters (e.g. latency, bandwidth).

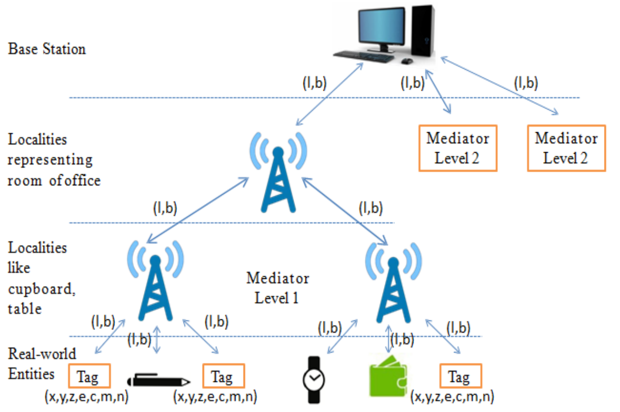

Figure 3: Proposed Architecture

The different parameters are defined as follow

x,y,z – the virtual location coordinates

e – Energy level of a node

c – Computation power of a node

m – Available memory of a node

n – Number of nodes being serviced by a server node each link between the nodes have two parameters

l – Latency of a connection

b – Transmission capacity of communicating nodes

In Virtual Coordinate System each tag is assigned with a coordinate which represents it physical location relative to other tags. It might not be real coordinates but in sensor networks virtual coordinates are enough for routing purpose. Now instead of focusing on only coordinates of the system we can also take the seven features listed above in to the account for finding optimal service provider. We are considering the n-dimension plane which consists of this seven feature as seven axes.

Our proposed system consists of a one or more mediator. The tag communicates with the mediator and the mediator communicates with the base station. User can also assign the weights to these measures like if user wants a service that requires higher computation then weightage to that particular measure (computation cost) will be high and ranking will be done accordingly. In case when user has not specified any parameters each attribute will be given equal priority.

The base station communicates with the tags with the help of two mechanisms that is push and pulls approach. Push and pull approach are used for real time updates.

Push approach is used for the objects that are misplaced frequently and are required in an emergency. Pull approach is used for the objects that are static and are hardly displaced.

Communication Paradigm	Advantages	Disadvantages
Push Based Approach	Faster Search	High n/w traffic, Huge database, Energy inefficient
Pull Based Approach	Energy efficient Less traffic	Slow response to user query

Table for communication paradigm

In our proposed idea we are using a hybrid approach of push and pull to find the objects in real time.

3.3 Implementation

System modules: Tags

Tags are the lowest layer items which represent the various static and dynamic objects in a given environment like shoes, cupboards etc. Each base station consists of a database where the location of the objects is stored based on the tags that are assigned to the object. There are two types of tags:

Push tag

These are the item which will keep broadcasting the items periodically. Items which are needed immediately and are frequently misplaced like keys, wallet makes use of push tag so that they can be instantly found.

Pull tags

These are the items which are relatively more static. These tags will only transmit the location when a user queries for the particular item. Items which are not an immediate requirement and which aren't frequently moved use pull technique.

I. Push approach

Tags under push approach will keep on broadcasting the data which is received by the mediator of that region. A mediator can be connected to any number of tags. Each mediator is in turn connected to the base station. Once the tag sends the data to the mediator, the mediator will make an array of the data that is been received and will pass it to the base station.

1. Add tag-data to the structure 'push message'.
2. Broadcast the message to immediate mediator.

Algorithm for push approach

II. Pull approach

Pull approach are used to tag the object which are relatively static in nature. Unlike push tag, pull tags will not transmit any data periodically. Pull message is the message sent by the tags under pull approach to the mediator or the base station.

Pull message consist of the following structure:

- requiredID-requiredID is the ID of the tag to be searched.
- mediatorID- Each mediator consists of a unique identification number.ThetagID which is requested by the user is in the nutshell of the mediator assigned to that tag.
- flag-They are used for pull request and pull reply.

If flag is 0, then it's a pull request

If flag is 1, then it's a pull reply.

```
1. Wait for incoming message having "Pull
   Message" structure in it.
2. If('requiredID'==own tagID )
   {
   -Mark "flag"=1;
   -Set 'mediatorID'= source tag id;
   -Send message back;
   }else
   Ignore
```

Algorithm for pull approach

A. *System modules: Mediator*

It is used to pass the data from the tags to the base station and vice versa.

Mediator consists of the following structure:

- mediatorID-the mediator consist of a unique identification number.
- Size-number of tags under each mediator
- tags[n]-Each tag consists of a unique identification number.

```
1. wait for incoming message
2. check the structure contained in packet
   -If it's "Push Message", add tag id to the local
   array
   -If it's "Pull Message", Using flag check whether
   it is user request or reply.
      • If it is a user request the broadcast it to
        all tags.
      • If it is reply then pass it to the base
        station
```

Algorithm for Mediator

B. *System modules: Base Station*

The mediator sends the data collected from the tags to the base station. Base station contains a collection of data from the mediators and the tags. It provides the query interference and displays the results .It maintains the current location of all the items and updates them as it changes its location.

```
1. User queries for some item:
   -If it is an item using `Push Approach', show
   location from local database.
   -If it is an item using `Pull Approach', prepare a
   user request packet and broadcast it.
2. Show results through GUI.
```

Algorithm for Base Station

V. ANALYSIS OF PROPOSED TECHNIQUE

In this section we provide analytical results to our proposed solution for further implementation process.

Dimension	**snoogle**	**MAX**	**OCH**	**Our proposal**
Aggregation type	Hybrid	Pull	Push	Hybrid
Query type	Ad hoc	Ad hoc	Continuous	Ad hoc continuous
Query mode	keyword	keyword	keyword	keyword
Query scope	local	Local	Global	local
Query time	Real-time	Real-time	Real-time	Real-time
Query accuracy	Heuristic	Heuristic	Heuristic	Exact
Query content	static	static	dynamic	dynamic
Mobility	yes	no	yes	yes

COMPARISION TABLE

As we can infer from the table, our proposed technique uses hybrid approach comprising of both push and pull to maintain real time data. There are two types of queries possible the ad hoc mode indicates one-time queries where result is returned immediately. While continuous types of queries are active for period of time and matches are returned while the query is active. Query mode is the mode by which the search engine can be implemented. Query scope can be local or global. Our proposed method comprises of localized search, it can be globalized with the help of many small localized networks. Query time indicates the time at which the Query is displayed. It can be either real time or historic. Query accuracy is the accuracy of the result with the real result. Query content can be both static and dynamic. Mobility defines whether system supports movable tags or not.

As we are using a hybrid approach along with Ad hoc and continuous type of Query which is backed up with the different parameters the result tends to be exact. The query content can be static as well as dynamic and it offers mobility as we are using a hybrid approach.

VI. SYSTEM OPERATION

If the object to be found is a static object then pull approach is applied whereas if it is a dynamic object then push approach is applied. A query is displayed where the user enters the id of the object to be found. This is shown in the figure 4 and figure 5.

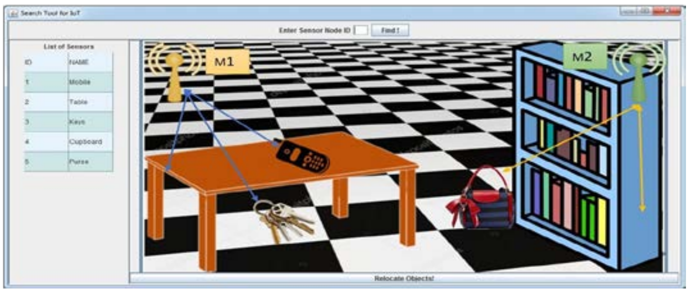

Figure 4: Query Interference

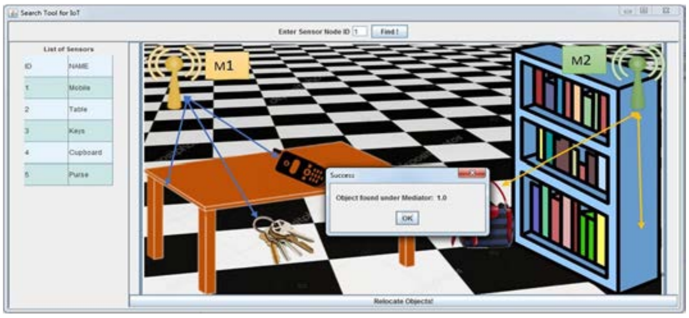

Figure 5: Result

VII. CONCLUSION

In this paper we propose virtual coordinate system using a hybrid approach of push and pull in search technique for Internet of Things. It considers more features like available memory, computation cost, energy level and other features to find the optimal service provider. It is scalable, provides quick result and requires minimal setup.

The future work mainly consists of implementation of the hardware of the proposed technique.

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