Smart Phone Detection for Proximity Estimation

Ms. Priya Sasane[1], Dr. S. T. Singh[2]
Department of Computer Engineering
[1, 2] P.K. Technical Campus Pune, India

Abstract- *As Today's word is Internet word, Everyone uses internet for their daily uses along with some Social Sites and Social App's, which results into the reduction of Face-to-Face Communication between individuals. According to sociologists if such facility increases or decreases face-to-face interactions, then what will be the use of such Social Applications? In this paper we calculate Proximity Estimation between devices and then suggest whether to use social application for communication or not. To Calculate Proximity estimation we can use Bluetooth, GPS, Wi-Fi approaches for calculating distance between devices. Such approaches have their own Advantages as well as Disadvantages also. For Calculating proximity estimation between device's we can also use BlueTooth, which is now commonly available on Smart Phones. So to calculate proximity estimation using Bluetooth we design one Proximity Estimation Model to determine the distance based on the RSSI values of Bluetooth and light sensor data in different environments. We compare Bluetooth proximity estimation on Android with respect to accuracy and power consumption with GPS and Wi-Fi.*

Keywords **-** Bluetooth , Proximity Estimation, RSSI, Smart Phones.

I. INTRODUCTION

Social media are virtually developed tools that was used by people to create, share or exchange information, ideas, and pictures/videos or to communicate with each other in virtual environments and networks. Social media is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content like messages, ideas and pictures/videos. Furthermore, social media depend on mobile and web-based technologies to create highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content. Social Media introduce little and temporary changes to communication between organizations, communities, and individuals. These changes are the focus of the emerging field of techno self studies.

Along with advantages there are some Dis-advantages of social media like Possibility for hackers to commit fraud and launch spam and virus attacks , decreases Face to Face communication between people's , it is just a virtual space, nothing can replace the real communication. Also may be chances that people cheat each other for personal purpose may be etc. To avoid this or to increase Face to Face communication between peoples we use Proximity Estimation model which will suggest user their nearness distance with each other. Proximity Estimation model will be built using Wi-Fi , GPS and Bluetooth. Proximity estimation model will calculate nearness distance between device's/people's. As Bluetooth is now available on all phone's with low cost so we are using Bluetooth for calculating distance between devices.
Estimation model which will suggest user their nearness distance with each other. Proximity Estimation model will be built using Wi-Fi, GPS and Bluetooth.

There are number of solutions available for Location Based calculation which uses technology as Wi-Fi ,GPS and Cellular triangulation or we can use the combination of all these. But all these technologies have their own advantages as well as Dis Advantages also. One more technology that is easily available with low hardware cost is Bluetooth which is also used for calculating proximity estimation between devices. Table I compares available proximity estimation technique.

Table I
Different Proximity Estimation Technique Comparison

	Bluetooth	**Wi-Fi**	**GPS**
Hardware Cost	Medium	High	High
Coverage	High	High(Indoor)	High(Outdoor)
Power Usage	Medium	High	High
Accuracy	1-4 m	2-30m	5-50m
Security	High	High	NA

The rest of the paper is organized as follows. Section II defines the proximity Estimation problem formally. Section III presents the previous work required to understand the problem and the details about Bluetooth and RSSI value. Section IV proposes the Proximity Estimation model and it's required input. Section V compare the used technology with available technologies in case of power(Battery) usage. Section VI design the Proximity Estimation model and the necessary condition for calculating Proximity Estimation. Section VII define the result of the paper and section VIII conclude the paper.

II. PROBLEM DEFINITION

To Develop Proximity Estimation Model using Bluetooth on Smartphone's(Android) to enhance Face-To-Face communication between people.

III. RELATED WORK

Section A gives literature review for Proximity Estimation calculation and Section B gives technical details of keywords.

A. Literature Survey

There are number of technologies which support Proximity Estimation.

Avik Ghose, Chirabrata Bhaumik , Tapas Chakravarty [1] presented an BlueEye model For Calculating Proximity Distance between mobile devices using Bluetooth, Blue Eye model also uses relative orientation of mobile phones along XY axis considering space and time. Blue Eye calculate proximity between devices at public places like Malls,shops where there is huge crowd. It will consider threshold value for nearness is less than 8 feet..

Audline Beena. S. P, IIUma Maheswari.V [2] design model For Calculating Proximity Distance between mobile devices using Bluetooth RSSI value and Atmospheric pressure. Application consider these two parameter in different environment also. It uses Multiple threshold value along with Data smoothing technique to yield reasonable approximations for proximity.

s. Liu , Aaron Striegel [3] proposed Proximity between devices can be calculated with the help of Bluetooth RSSI value and Light Sensor Data. They also compare Bluetooth , Wi-fi and GPS Location based technique for Accuracy and Battery Consumption Purpose. Result found that Bluetooth gives more accurate result along with Low battery Consumption.

G. Treu and A. K€ upper and L.Siksnys, J. Thomsen, S. Saltenis, and M. Yiu, [4][5] suggested proximity estimation events will be automatically generated without user involvement. It will identify nearness between devices when user enter into the particular zone. Such approach uses low communication cost because there is no need to keep continuous tracking of system/device.

V. Zeimpekis, G.M. Giaglis, and G. Lekakos,[6] proposed there are number of technologies available for location based service like Wi-Fi and GPS. Such application have their own advantages as well as Disadvantages also. They analyze these available technique with each other considering cost, accuracy factor in mind.

M. Bilgi, M. Yuksel, and N. Pala [7] suggested there is another three-D optical wireless based location technique which uses both GPS and triangulation technology.

Md Osman Gani, Casey O'brien, Sheikh I Ahamed, Roger O Smith [9] proposed Global Positioning system is a recently used Localization system have low accuracy inside of building. There is another method for indoor localization system that is Wi-Fi but that is suitable in case of Indoor while it requires extra Infra Structure Support and having low accuracy in outdoor case.

A. Kotanen, M. Hannikainen, H. Leppakoski, and T. Hamalainen, [10] Presented design , architecture and Implementation of Bluetooth for calculating position of device. Result proved that Bluetooth gives accurate result for Proximity Estimation between Devices.

R. Want [11] suggested Ultrasound approaches such as Active badge Location system which provide good accuracy but they require infrastructure support for locating devices. This system also support high Security same as Wi-Fi.

E. Mynatt, M. Back, R. Want, and R. Frederick, [12], proposed proximity can also be calculated by sounds, and it has been proven audio to be effective for delivering peripheral cues.

K. Li, T. Sohn, S. Huang, and W. Griswold [13] suggested that Mobile Phones are useful tool for detecting Location of user. So such Mobile Phones are used to calculate Proximate Estimation between devices. Such system avoids sensor noise and also consumes low power as compared to other Location based technique. For detecting proximity they compared the cell towers seen by the mobile phones to estimate proximity. They also take the advantage of mobile phones hardware components.

A. LaMarca et [14] presented Place Lab application to estimate device position using Cell ID of fixed radio beacons. They also analyze Bluetooth as a tool for calculating location of device.

H. Liu, H. Darabi, P. Banerjee, and J. Liu [15] analyzed different Indoor Positioning technique. Such comparison includes Accuracy , Precision, Complexity ,Scalability , Robustness and Cost like Wi-Fi.

B. Bluetooth and RSSI

Now a days Bluetooth is in-built option available on all device's regardless of manufacturer of company.Bluetooth is a open wireless technology used for exchanging data over a short distance from one mobile device to the number of other mobile device. Bluetooth is easily available on all device's.

Similar to Wi-Fi connections, Bluetooth uses a radio as a means of communication; first thing to do is check the signal strength, which is computed for Bluetooth devices as a Received Signal Strength Indication (RSSI) value.Now a days Bluetooth facility is easily available on all type of mobile devices. Each device bluetooth calculate RSSI value with each other.

RSSI value can be used to find distance between two device's. Whatever signal strength reveived by receiver will decide nearness distance.The longer the distance to the receiver device, the lesser the signal strength at received side device. Theoretically, the signal strength is inversely proportional to squared distance, and there is a known radio propagation model that is used to convert the signal strength into distance. But, it becomes difficult to calculate distance using RSSI because of noises, obstacles, and the type of antenna orientation or any other environmental factors/obstacles. In such case it is necessary to make our system environment independent , where values of RSSI and distances are evaluated ahead of time in a controlled environment. The advantage of using bluetooth is its low cost, because most receivers can estimate the received signal strength and its easily availability on devices.The disadvantage of using Bluetooth for calculting distance between devices is that it is affected by noise and interference or by any other environmental obstacles.

IV. SYSTEM DESIGN AND IMPLMENTATION

Our Application collects the Bluetooth RSSI value, MAC address ,BTID value of nearby Bluetooth enabled device's data. Store the collected data periodically on SQLite Database or on MySql database also. The Distance between two device's will be calculated according to the RSSI value. Calculated distance will be updated and stored into the database periodically. RSSI value may vary according to the location where device is in i.e. either device is indoor or outdoor. So to handle such situation we also get Light data as input to decide device location (Indoor/Outdoor). Our application also collects Latitude and Longitude of device using Wi-Fi or GPS. Such network provider application consumes battery power of device so to avoid this we also collect battery data along with time.

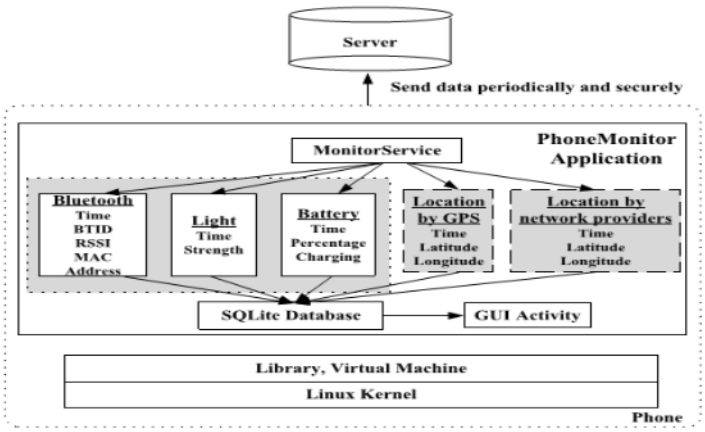


Fig.1 System Architecture

We use this data for analysis purpose with Bluetooth. All this input data will be used by our application. Such data will be periodically updated and stored on database. Such Input will be used by our system to calculate proximity distance between device's. Proximity Distance value may vary according to the Indoor and Outdoor condition. Collected Input data value may vary according to the device availability.

V. POWER COMPARISON

As smart phone has low battery power as compared to other smart devices or laptops. So here we need to consider this parameter also.Device battery consumption is one of the most important factors in application. Because battery level in smart phone's is less as compared to PC. We are using Bluetooth as proximity estimation calculation. There are other options available for proximity calculation i.e. Wi-Fi and GPS. In this application we are comparing battery consumption by these three approaches. This application collects battery level data after 30 seconds interval repeatedly. This application starts when the phone is fully charged and stop when the phone is out of battery. After performing analysis it is clear that battery consumption using Bluetooth is less as compared to other approach. Fig.2 shows that the battery consumption using Bluetooth is less as compared to Wi-Fi and GPS.

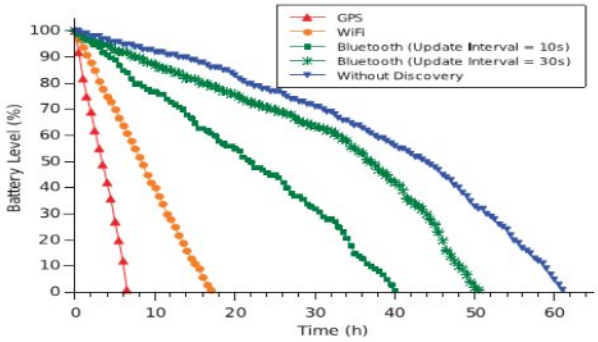


Fig.2 Energy consumption of Bluetooth ,Wi-Fi and GPS

VI. PROXIMITY ESTIMATION MODEL

For Calculating Proximity Estimation using Bluetooth we need to use RSSI values of Bluetooth and light sensor data in different environments. We also have to consider cases like device is Indoor or Outdoor along with whether device is in bag or not. Whatever RSSI values we are getting are different according to the Cases.

We have to consider these cases because RSSI value get disturbed by noises , external environmental factors.
We also need to consider threshold value which is the limit for considering device is in direct communication range. But single threshold value does not give constant proof's or values may get fluctuate according to environmental factors so to avoid this need to use Multiple threshold value using Data smoothing technique and Light Sensor Data. For performing Data smoothing we use simple window function and each RSSI i at time i is modified using following function as:

$$RSSI_i = a * RSSI_{i-1} + b * RSSI_i + c * RSSI_{i+1} \quad (1)$$

For the values of the parameters (a, b and c), several combinations such as (0.4, 0.6, 0), (0.3, 0.4, 0.3) and (0.2, 0.6, 0.2) are used in the following comparisons. Another smoothing technique is EWMA (Exponentially weighted moving average) to analyze the data set. Let Ei be the EWMA value at time i and s be the smoothing factor. The EWMA calculation is as follows:

$$E_i = s * RSSI_i + (1-s) E_{i-1} \quad (2)$$

Using first smoothing technique we use (0.3, 0.4, 0.3) combination for (a, b, c) and using second method smoothing factor will be 0.5. We are using Light sensor data to identify device is inside or outside of building for the same we are getting different RSSI value. Table II shows the Light sensor value data at different environment condition as :

Table II
Environment Estimation with Light Sensor Data

Light Sensor Data	Environmental Estimation
(0,100)	Inside Backpack
(100,1280)	Indoor and out of backpack
> 1280	Outdoor and out of backpack

If calculated RSSI value is in particular range according to table III then it means devices is in Positive Zone otherwise device is in Negative Zone. Along with positive and negative zone there is High Probability zone which indicates that device are in Face-to-Face communication range along with high probability of communication.
While Low Probability zone indicates devices are in direct communication range but chances for direct communication in this zone are very low. Below value indicates the Bluetooth RSSI value range for different zones. For Positive Zone values will be up to -55 and -60 for Indoor and Outdoor respectively. For Negative Zone values will be -76 dBm onwards and -90 dBm onwards for Indoor and Outdoor respectively. For High Probability Zone values will be -55 dBm to -65 dBm and -60 dBm to -75 dBm for Indoor and Outdoor respectively. Similarly for Low Probability Zone values will be -65 dBm to -76 dBm and -75 dBm to -90 dBm for Indoor and Outdoor respectively. Table III shows the RSSI value range in different Zone.

Table III
Multiple Threshold range in zone wise

	Indoor	**Outdoor**	**Inside Backpack**
Positive Zone	Upto -55dBm	Upto -60 dBm	Upto -60 dBm
High Probability Zone	-55 dBm to -65 dBm	-60 dBm to -75 dBm	-60 dBm to -70 dBm
Low Probability Zone	-65 dBm to -76 dBm	-75 dBm to -90 dBm	-70 dBm to -76 dBm
Negative Zone	-76 dBm onwards	-90 dBm onwards	-76 dBm onwards

After getting Bluetooth value X_i and light sensor value Y_i at time i we will calculate probability of face-to-face proximity P_i as described in algorithm.

Algorithm 1 Estimate probability p_i of face-to-face proximity with Bluetooth RSSI value x_i and light sensor value y_i

$x_i \leftarrow a * x_{i-1} + b * x_i + c * x_{i+1}$
determine the scenario depending on y_i
if x_i *is in positive zone* **then**
  $p_i \leftarrow 1$
else if x_i *is in probability zone* $[B_{min}, B_{max})$ **then**
  $p_i \leftarrow (x_i - B_{min})/B_{range}$
else
  $p_i \leftarrow 0$
end if

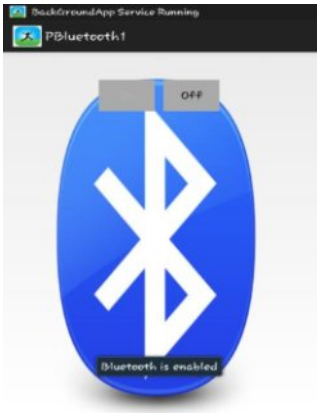
If probability is greater than 45 percentages then two phones are considered to be in the face-to-face proximity. The larger value of Pi the more accurate face-to-face proximity we can obtain.

VII. RESULT

With the help of Bluetooth our system will collect Bluetooth RSSI value and Light sensor value. By applying multiple threshold value (Data smoothing technique) we will calculate RSSI value considering Environmental factors also.

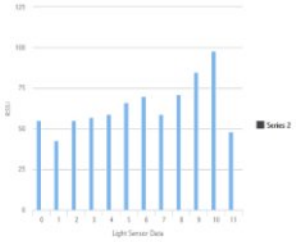
Calculated RSSI value partitioned into four types of Zone. Different zone will decide nearness between the devices. After getting Bluetooth RSSI value and light sensor value we will calculate probability of Face-to-Face communication between devices by using algorithm. We will also compare battery consumption by Wi-Fi, GPS and Bluetooth which results into the fact that Bluetooth consumes less battery as compared to other technique. Using Bluetooth we are also getting accurate result as compared to Wi-Fi ,GPS.

After successful login user can set Bluetooth on-off.



After Bluetooth enabled user see the Bluetooth enabled device which is in positive zone. Bluetooth RSSI value ,latitude ,longitude, battery level value and Calculated probability value gets stored into MySql database . Data will be updated periodically after 30 seconds. Probability with value 1 indicate positive zone , 0 value indicates negative zone and values between them indicate High Probability Zone and Low Probability Zone. Depending on that user will be prompt.

User also able to get RSSI value against Light Sensor Data.



VII. CONCLUSION

Using the advantages of Bluetooth we are building Proximity Estimation model on Smart phone's which increases the Face to Face communication between people. Proximity Estimation can be also calculated using Wi-Fi and GPS. But these network provider has some disadvantages .This application helps the people who are in same room still usage social media for communication. Application suggest such user that you are in direct face to face communication range, it increases direct Face-to-Face communication between people.

ACKNOWLEDGMENT

I would like to take this opportunity to express my profound gratitude and deep regard to my Guide Dr.S.T. Singh Sir for her exemplary guidance, valuable feedback and constant encouragement throughout the duration of the project. His valuable suggestions were of immense help throughout my project work. His perceptive criticism kept me working to make this project in a much better way. Working under him was an extremely knowledgeable experience for me.

REFERENCES

[1] [1] Avik Ghose, Chirabrata Bhaumik , Tapas Chakravarty , "BlueEye – A System for Proximity Detection Using Bluetooth on Mobile Phones" "Experiments on Local Positioning with Bluetooth,"Information Technology: Coding and Computing (ITCC '03), pp. 297-303, 2003.

[2] Audline Beena. S. P, IIUma Maheswari.V "Multiple Threshold Based Method with Data Smoothing and Atmospheric Pressure Using Bluetooth on Smartphone's International Journal of Advanced Research in Computer Science & Technology (IJARCST 2014).

[3] S. Liu and A. Striegel, "Accurate Extraction of Face-To-Face Proximity Using Smartphone's and Bluetooth,"

Proc. 20th Int'l Conf. Computer Comm. and Networks (ICCCN '11), pp. 1-5, 2011.

[4] G. Treu and A. K€ upper, "Efficient Proximity Detection for Location Based Services," Proc. Workshop Positioning, Navigation and Comm. (WPNC '05), 2005.

[5] L.Siksnys, J. Thomsen, S. Saltenis, and M. Yiu, "Private and Flexible Proximity Detection in Mobile Social Networks," Proc.IEEE 11th Int'l Conf. Mobile Data Management (MDM),pp.75-84, 2010.

[6] V. Zeimpekis, G.M. Giaglis, and G. Lekakos, "A Taxonomy of Indoor and Outdoor Positioning Techniques for Mobile Location Services," ACM SIGecom Exchanges, vol. 3, pp. 19-27, Dec.2002.

[7] M. Bilgi, M. Yuksel, and N. Pala, "3-D Optical Wireless Localization," Proc. IEEE GlobeCom, pp. 1062-1066, 2010

[8] F. Izquierdo, M. Ciurana, F. Barcelo, J. Parsssadells, and E. Zolssssa, "Performance Evaluation of a TOA-Based Trilateration Method to Locate Terminals in WLAN," Proc. First Int'l Symp. Wireless Pervasive Computing, pp. 1-6, Jan. 2006.

[9] Md Osman Gani, Casey O'brien, Sheikh I Ahamed, Roger O Smith , "RSSI based Indoor Localization for Smartphone using Fixed and Mobile Wireless Node" 2013 IEEE 37th Annual Computer Software and Application.

[10] A. Kotanen, M. Hannikainen, H. Leppakoski, and T. Hamalainen, "Experiments on Local Positioning with Bluetooth,"Information Technology: Coding and Computing (ITCC '03), pp. 297-303, 2003.

[11] R. Want, A. Hopper, V. Falc~ao, and J. Gibbons, "The Active Badge Location System,"ACM Trans. Information Systems, vol. 10, no. 1,pp. 91-102, 1992.

[12] E. Mynatt, M. Back, R. Want, and R. Frederick, "Audio Aura:Light-Weight Audio Augmented Reality,"Proc. 10th Ann. ACMSymp. User Interface Software and Technology, pp. 211-212, 1997.

[13] K. Li, T. Sohn, S. Huang, and W. Griswold, "Peopletones: A System for the Detection and Notification of Buddy Proximity on Mobile Phones,"Proc. Sixth ACM Int'l Conf. Mobile Systems, Appli-cations, and Services, pp. 160-173, 2008.

[14] A. LaMarca et al., "Place Lab: Device Positioning Using Radio Beacons in the Wild,"Proc. Third Int'l Conf. Pervasive Computing, pp. 301-306, 2005.

[15] H. Liu, H. Darabi, P. Banerjee, and J. Liu, "Survey of Wireless Indoor Positioning Techniques and Systems,"IEEE Trans. Systems, Man, and Cybernetics, Part C: Applications and Rev., vol. 37, no. 6, pp . 1067-1080, Nov. 2007