

Cell Phone Based Wireless Sensor Networks For Social Fidelity Via Cooperative Data Sharing

Wilson Thomas

Research Scholar
Sri. JJT University, Rajasthan, India

Shabbeer Basha

Asst. Professor
MITS, Madanapalle, Andhrapradesh

Abstract— the universal character of cell phone and the modern encroachment in the cell phone technology and evolution of smart phones have created a new room for researchers in the domain of wireless sensor networks (WSN). It created a new paradigm of using the cell phone as sensor device and so called sensor enabled cell phone based data sharing. The proposed method of sensor data sharing uses the cell phone as the sensor device and motivate the public to use their cell phone as sensor device and contribute for data sharing to the knowledge bank and increase the availability of real time data in the knowledge database. The special categories of sensor embedded smart phones, which can sense multiple parameters like motion, temperature, pollution etc.. are developed for this purpose. Using these smart phones different users at different locations are invited and coordinated for data sharing. This is more or less the social commitment and responsibility of and individual towards his society. The collected data can be used for improving the well being of human beings.

Index Terms—Cell Phone based WSN, sensor embedded cell phone, user privacy, protocols, android.

INTRODUCTION

It is estimated that the number of mobile phones in the world will exceed the world population by mid of 2014 [2]. These cell phones can be embedded with different application specific wireless sensors like camera, microphone, radiation sensor, pollution sensor, bio sensor etc. In addition to this with the help of GPS and web services we can aggregate and interpret the assembled information from different locations. It creates a new paradigm for sensing—where people participate in sensing and analyzing aspects of their life and try to find out a solution for the social problems they are facing in their normal life. If we consider an individual sensor node it may be cheap, but the employment of huge number of sensor nodes makes the traditional wireless sensor networks expensive. If wisely used these sensor embedded cell phone devices can be used for a wide variety of

applications since it is remarkably affordable and sharable. Using cell phone as sensor node [1][13] quite a lot of money and infrastructure could be saved by decreasing the number of sensor nodes in locations where mobile phone users exists. Some of the benefits of using sensor embedded cell phone [3][14] as a sensor device are listed below.

I. **Traffic management & pollution control:** Consider the situation of heavy traffic at a particular place in a city. Many people spend much time in traffic, waiting for the red signal to turn green. If these people spend few seconds to collect the traffic or pollution statics using their cell phone and share this information to the knowledge database it would be useful for the other commuters to select an alternate root or divert the direction of an ambulance coming in that root, with a medical emergency and would possible save some one's life.

II. **Crime control:** The cases of illegal activities like, illegal sand mining, drug & sexual offences and related crimes, corruption etc can be controlled more effectively and the culprits could be nabbed if the people who witness the incident use their cell phone to record the same and share that information via social Medias or to the concerned authorities.

III. **Medical Care for people:** Smart phones and web technology can be used to supply information to senior citizens [8], their relatives, and health center regarding changes in everyday life of a person that are early warnings of retreating health.

IV. **Habitat monitoring and wild life protection:** Cell phone based sensor devices can be used to monitor the habitat of birds and animals [9] whose population is dwindling. The crimes like hunting, animal torturing etc can be controlled by this.

v. **Garbage management:** Garbage management has become a serious problem in metros in India. Disposing this huge amount of waste produced every day, including the bio-waste is a dreary task for the municipality. Have no proper attention if given to garbage management it would cause for spreading of epidemic like chikungunya, dengue, malaria etc.

vi. **Other Benefits:** The other benefits of using cell phone based wireless sensor networks are controlling water and electricity wastage. Anyone who carry a smart phone if observe the water or electricity wastage happening he/she can immediately collect the visual proof and share it via social media and bring it to the attention of authorities so that the wastage can be controlled.

vii. **Challenges**

The deployment of such cell phone based WSN becomes a challenge [15] because the cell phone users are dynamic and wireless networks are relatively static. To develop the hardware module we need to embed different application sensors like motion sensor, temperature sensor, vibration sensor, etc with mobile phones. The application specific software need to be developed.

viii. **Security:** It is mandatory to provide security for the data as well as we need to preserve the identity of the person who shared the information. Only authenticated persons will be allowed to participate in data sharing. This is done to prevent misuse of the system. Cell phones works together based on the concepts of participatory sensing which includes amenable information such as ones personal data like photographs or any other personal information and the participant's location identified over time [11],[12]. So encryption of the data allows sharing it only with people we trust.

ix. **Addressing problem:** Multi-hop Routing [4],[14]in Wireless Sensor Networks is enormously challenging due to the native distinctiveness. Now a day's most of the smart phone uses internet and the number of IPV4 addressees are diminishing. There is no globally unique address system and massive number of internet based devices makes it more multifarious.

x. **Routing Protocols:** The different categories of routing in WSNs [5] are data-centric routing, hierarchical based (cluster based) routing, and location based routing depending on the type of networks.

xi. **Sensor Embedding in Cell Phone:** A variety of Sensors are embedded [6] in the smart phones now days. Some of these sensors are Microphone, camera, ambient light sensor, accelerometer, proximity sensor digital compass, Gyroscope, etc. The GPS system used in smart phones helps to locate the position of the device. These

sensors can be used for different applications like multimedia, Gaming etc.

Wireless sensor networks (WSN) are promising technology [7] that builds upon the topical developments low-power embedded systems, MEMS-sensor design, electrical, mechanical engineering, wireless networking technologies network architectures and instrumentation applications. This work addresses the problems people face in their day today life and helps to provide solutions to their problems and a better living style in an effective way with the help of cell phone technology. The avoidance or negligence of a person can create serious impacts on the society. Such situations need to be handled carefully in time and necessary actions needs to be taken. This work collaborate the sensor networking technology and mobile phone technology. Thus the methodology presented herein may serve as a model for similarly sized programs.

xii. OBJECTIVES

1. To divulge the problems we are facing in our daily life like air pollution, wastage of resources like electricity and water, garbage mismanagement, corruption, criminal activities, illegal selling of drugs, safety of women etc.
2. To collaborate with various NGOs and government departments like police, municipality, water and electricity department, lokpal etc.
3. Develop a sensor embedded phone capable of collecting the adequate data.
4. To develop a mobile application to send data from persons mobile to the centralized database for necessary actions/solutions.
5. To inform/aware the concerned authorities to take corrective/necessary measures and receive necessary action/solution about a particular problem being faced by the public.

XIII. RESEARCH METHODOLOGY

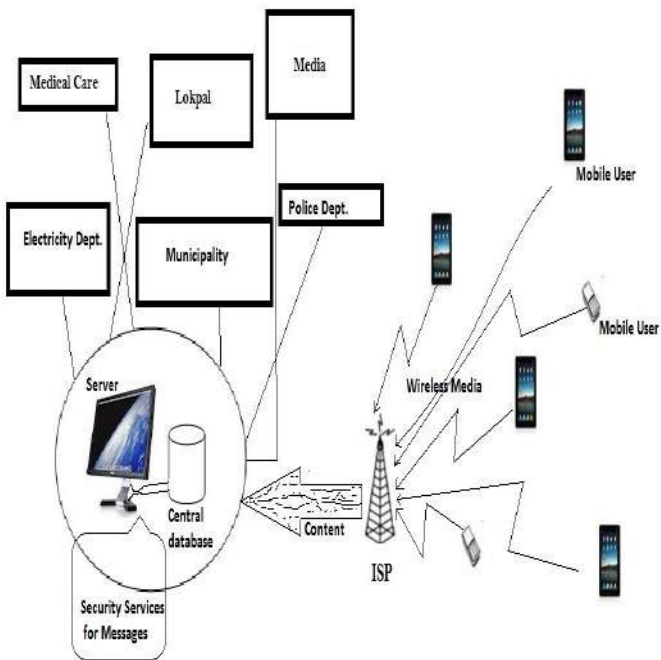


Figure 1: Project Overview Diagram

Figure1 shows the project overview diagram. A Person who is near to/victim of social problems/issues can use his mobile to collect the necessary information, which can be a picture of any incident, data like traffic details, air pollution readings etc. First an embedded hardware is developed where different applications specific sensors like temperature sensor, gas sensor, motion sensor, etc are embedded with the mobile phone. An android based application is developed which can collect data automatically if required, when turned on the auto sensing mode and forwards it to the database. The application is also used for manually submitting the user complaints. These mobile users are connected to their service provider. The collected data is then passed to a central data base for storage. Adequate security and safety is provided for the data and the identity of the person who is sending the data is preserved for safety purposes.

This data is then categorized and shared with the police department, lokpal, electricity department, municipality, other concerned authorities and various NGO's. In this way all the related authorities are collaborated with the project and the required corrective measure is taken with the support of public. These data can be shared via social networks like facebook, twitter etc

in case of any warning or awareness need to be shared among public. An energy efficient routing protocol is developed and security for the data is provided with data encryption.

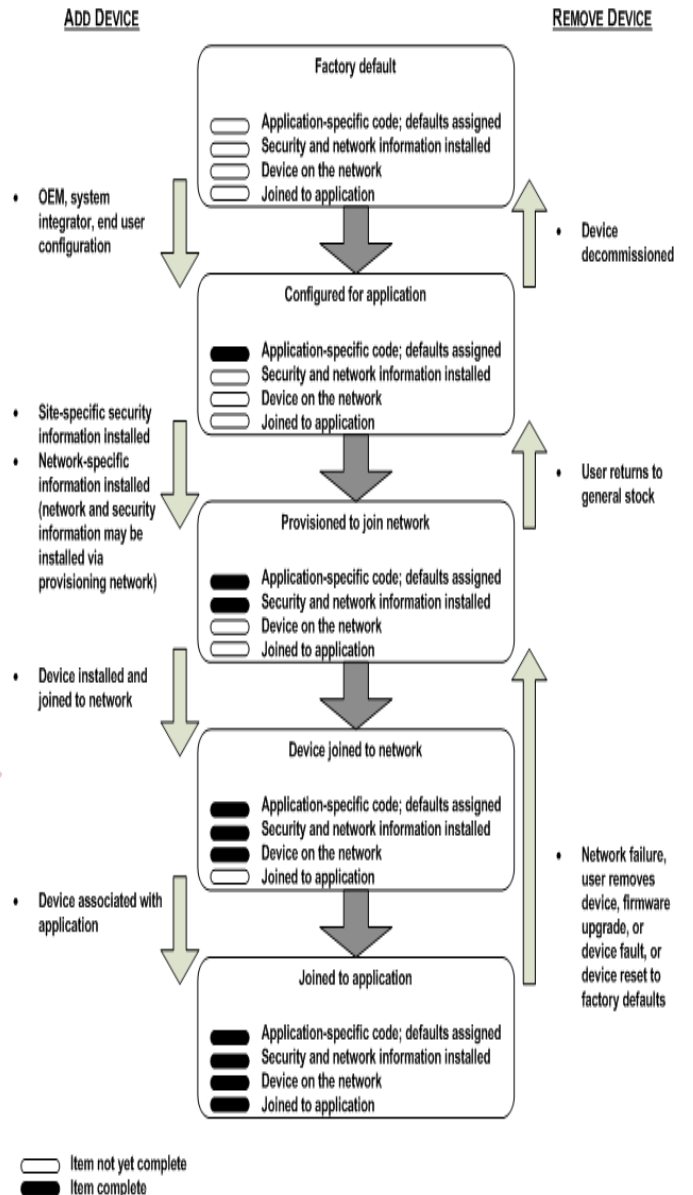


Figure 2: New devices joining and leaving the network
Figure 2 shows the process of joining and leaving of a new cell phone device to the cooperative data sharing network.

XV REAL TIME DATA COLLECTION ALGORITHM FOR CELL PHONE BASED WSN

Step 1: [Initialize]

Let A be the area of interest and N be the number of mobile phones present in that area for data collection.

[A is divided into subareas a1, 12, a3, a4... corresponding to different

user positions, and considering at least one user per area]

while(user is at the area of interest)

{

for(i=0;i<N;i++)

register user i with the network

Step 2: [Activate auto sensing mode for mobile phones]

for(i=1,i<=N;i++)

sense data from area ai and forward to destination

Step 3: Store the collected data into the data base.

Step 4: Categorize data

While(data in database= new data)

Forward to the authorities.

}

Step 5: Deregister user from the network

Step 6: End.

Transmission form

The power loss happen in propagation of radiowaves is given by equation 1. [16]:

$$Pr(r)=Pt/(4\pi r/\lambda)^2 \tag{1}$$

here P_t , $P_r(r)$ are the power at the sender side and receiver side respectively and r is the distance from the source. λ represents wavelength of the radio frequency signal. The mobile-phone intermittently transfer the collected data in Power classII with an utmost radiation power of 2dBW [17].

Power Model of Cell phones

With mobile phone based Wireless Sensor networks, the energy loss happen in two ways. One is the energy loss happen for making voice calls and other is by transmitting sensor data. The following method model the energy loss between sampling timings.

$$power(t)=power(t1)-(t-t1)Cmax/Tmax \tag{2}$$

here C_{max} is the power of the cell phone and T_{max} is the equivalent talk time. $power(t)$ and $power(t1)$ are the power available at timings $t1$ and $t2$, where $t1 < t$ and $t-t1$ is the time difference among different events.

XVI RESULTS

Following shows the snapshots of an android application developed for the people of Bangalore to register a complaint regarding any problem they face in their locality to the concerned authorities. Figure2 shows the user is provided with login option with different social websites to facilitate data sharing via social media. Figure3 shows a column to describe the complaint, and the user can even select the category of complaints. Figure4 shows an option to take a snapshot of the event and attach a file as a proof. Figure 5 shows how user can set the location of event using

Google maps and using GPS. Figure 6 shows an auto generated message received by user once a complaint is successfully posted.

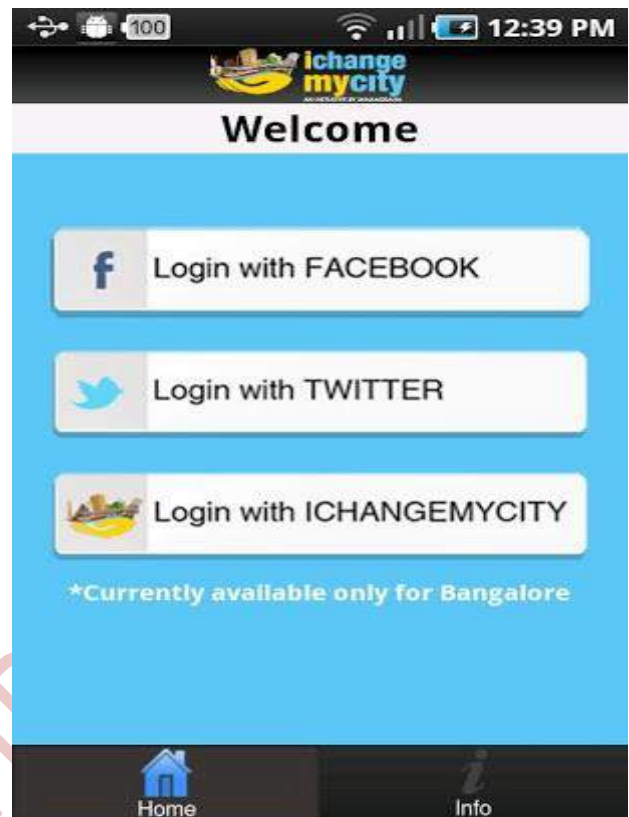


Figure 2: Login Options



Figure 3: Complaint Description

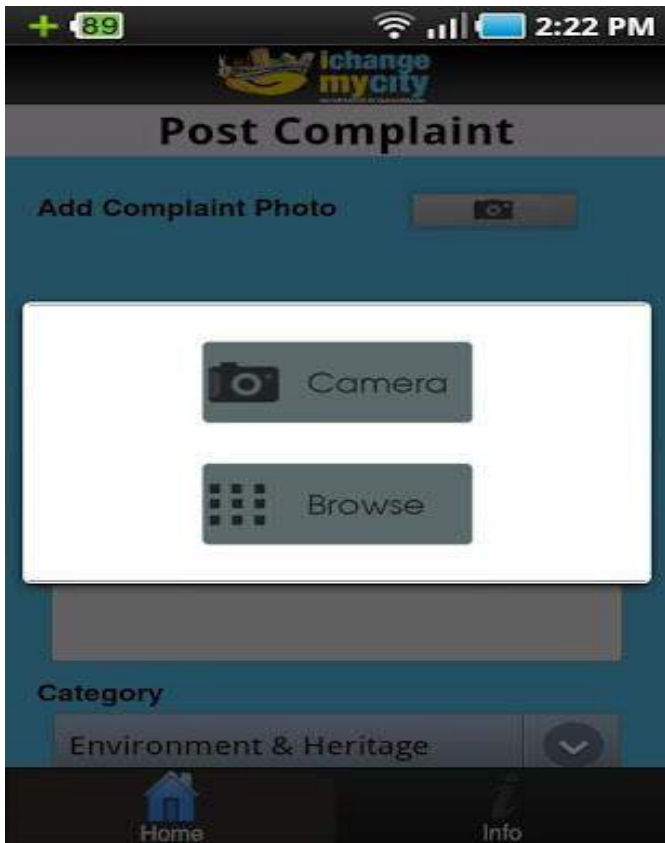


Figure 4: Attach photo/file for proof

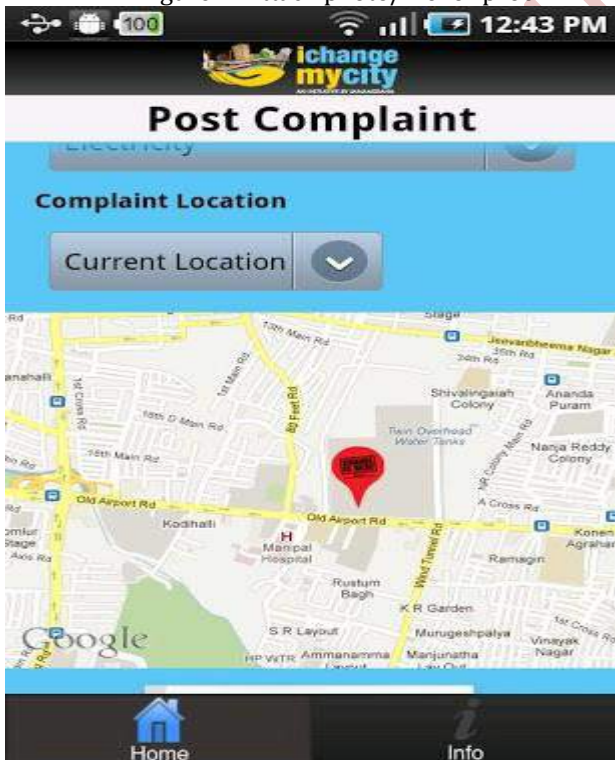


Figure 5: Add location of Incident

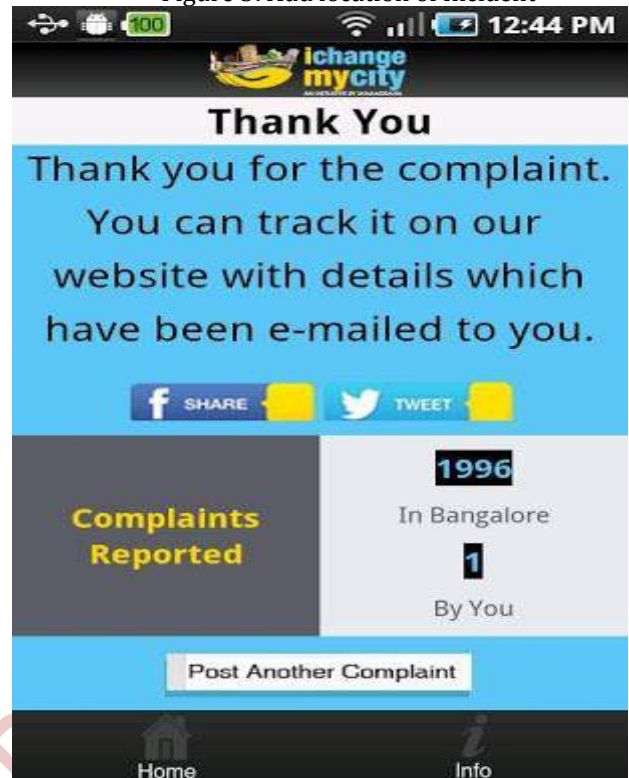
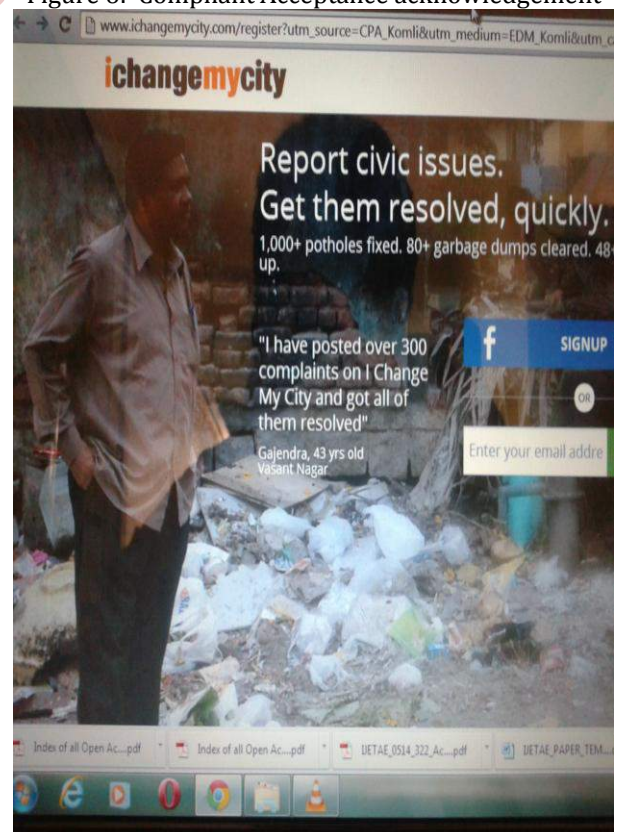


Figure 6: Compliant Acceptance acknowledgement



I-changemycity website snapshot

Survey Results

To analyze the effectiveness of this project we installed this application on 5 Samsung galaxy grand smart phones and taken feedback from 100 people from different places in Bangalore urban in India. The following table shows the feedback of people collected from different parts of Bangalore (India). Out of 100 people surveyed 85 % of people have responded positively whereas 10 % people talked about the difficulty in implementation and 5 % people showed no interest.

Sl No	Area of Survey	No of people surveye d	Do you think Cell phone based WSN useful for society?		Any suggesti ons?
01	Electro nic City	30	27 yes	3 No	Good applicati on, make it free of cost
02	White field	20	15 yes	5 No	Volunte ers required
03	ITPL	30	25 yes	2 No	Need publicity
04	Brigad e Road	20	18 yes	5 NA	Not interest ed

Table 1: User Feedback

XIV. FUTURE WORKS

We propose an approach to call for online campaign whenever we need to address a problem at particular area so that the localities will be informed in advance and a major contribution can be expected from the public. We also expect some volunteers to come forward and take it as a challenge to implement this project nationwide with the help of social networks. We also expect good cooperation and support from the government towards such initiatives.

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Mr. Wilson Thomas completed his M.Tech in Computer Networks Engineering from R.V. College of Engineering, Bangalore in 2010. He is a research Scholar in the area of Cell Phone Based Wireless Sensor Networks at JJT University Rajasthan, India.

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