Mobile Social Computing: Swarm Intelligence based Collaboration

Ahmad Hassan Afridi

***Abstract*—an ad-hoc network based intelligent system working on swarm intelligence principles for socializing system is being presented. The architecture relies on the distributed and decentralized nature and combines the swarm intelligence and crowdsourcing in mobiles. Mobile devices detect the current context, developing information structures about the person condition and inform the other people in the range so that business can be done. Such system can be useful for our daily life such as work, business, shopping or socializing. Daily shopping requires collaborating and asking for better quality and cheap prices items. Elderly care requires the family and community to collaborate and swarm. The system can also be used in emergency situations. This paper presents swarm intelligence based mechanism for distributed problem solving in ad-hoc networking environments.**

***Index Terms*—Management, Performance, Design, Reliability, Experimentation, Human Factors, Theory**

1. INTRODUCTION

Mobile Social informatics is everywhere now. Some situations offer computing challenge to the mobile information system. People communicate when they are shopping, or finding a rout to a destination without availability of a network. It can also be collecting information or socializing during emergency or when a tourist is visiting a new place. We in our attempt tr to propose an approach that is based upon the principles of swarm intelligence. Architecture of the software is based upon swarming of mobile devices, which results into formation of decentralized information sources on mobile devices socializing in emergency in possible ad-hoc net and sensing over a distributed area. The system is a step towards two ideas:

1. The prospects of social computing in our daily lives.
2. The application of swarm intelligence in pervasive devices.

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During emergency, the mobile communication system may not work properly due to damaged towers or congestions at the servers. The affected people can be reached and given help on time if there is some mechanism that provides information about the people in affected zone and this operation is done by mobile devices over ad-hoc Bluetooth network. Information should carry the information of affected persons. This situation stimulates the formation of a mobile devices swarm to make decentralized information sources.

Secondly, to bridge gap of information, deprived or downgraded mobile devices i.e. mobile device requires the usage of resources of other mobile device. The formation must exhibit decentralization and fault tolerance in the operating environment.

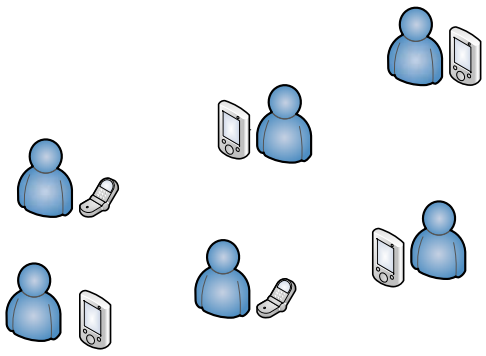

Figure 1: Mobile Social Computing

2. MOBILE SOCIAL COMPUTING

Mobile devices are dynamic in nature as more devices with diverse platforms, hardware and software capabilities; mobile devices number increases the opportunity for deploying swarm based solutions.

Swarming of mobile devices forms a link between the mobile devices but question is why this swarm is being formed. The swarm formation is for exploitation of the social capital. The social context of the mobile devices enable the people to take decision where the infrastructure is compromised and information about environment is too less. Parameswaran & Whinston argue Social systems are mostly decentralized, dynamic, loosely defined. The quality attributes to peer feedback and unstructured [1] . Middleware for formation of context aware social network are

ISBN: 978-988-19252-1-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

being developed [2]. The research focusing on algorithms and future pervasive social computing systems [3] and systems pervasive social relying on programmable consumer devices[4]. In developing such systems there is a need for investigating social context in border context aware perspective [5] and social computing focusing on mechanisms and social senses[6]. Social software and its operation in aspects as such as collaboration and broadcasting is very important [7]. Some case studies presents for crowd computing, a paradigm that defines that social integration usage do solve problem, living on opportunistic networks [8] . Knowledge capital is always there, as new people replace aging employees, tools are required to sustain the key attributes such as knowledge and creativity. Social computing focuses on four main attributes; messaging, collaboration, broadcasting and knowledge building [9] . In challenging situation where there is no infrastructure or there is some degradation of service, there is exploitation of the social capital. Mobile is a pervasive device and hence in order to consume the social capital, pervasive social computing must be the central theme for any compromised information system.

Recent trends show the pervasiveness of social computing, exploring the social context of user. The dynamics of emergency are that communication occurs in a small scope, short to medium level collaboration [12, 13]. Social computing in emergency and emergency has gained attention in recent years [14, 15]. Both of these project show that in emergency the community must provide its information on its own so that it is available for any possible help from rescuers side. Most of research focuses on people and places affinity [16, 17].

3. Mobile Usage and Related Factors

The ability to use mobile depends upon:

- Credit balance
- Signal strength
- Users abilities and disabilities
- Number of SIM with a user at a time
- Mobile devices capabilities such as GPS and internet.
- Short range communication
- Power/ electricity / charge

Balance and package are most important factor in communication during emergency management. The user can call more people and rescue agencies. In some cases the SOS calls are permitted to facilitate the people. Network congestion can also be a reason for non-available services. The user might be unable to use mobile device. Most people carry one or many SIM at a time of same or different companies. This increases the chances of survivability of person even if one network is not available. It enables usage of services such as map and other location software.

Elderly people can be taken care by forming a swarm over the regular online systems. But ad-hoc networks are difficult to maintain for a long time.

4. Requirements for Mobile Computing in Challenging Environments

There are two basic requirements for the mobile computing in challenging environment.

4.1 Structural Requirements

Structural requirements of the system demand that the mobile devices should form a social group or information structures during. Most mobile devices have less memory budget and limited processing power. The emergency management software in order to cover most people must consider this option in order to deploy the software across various devices. Due to the increase of various software platforms the software must be developed in a way that it addresses the issue of platform independence. Shopping assistants and people in a same family have multiple devices.

4.2 *Operational Requirements*

Software must be able to form a swarm using ad-hoc networking technologies such as Bluetooth. Network congestion may cause non availability of the services. During the emergency situation due to urgency or users disability; mobile devices are not used effectively. Software during its operation must act automatically to capture and respond to user's condition. It involves information of nearest mobile devices and support to Explicit and implicit user input. Dependable mobile computing requires to that the mobile devices software must be dependable and fault tolerant [10][11]. Even in markets if internet is not available the mobile should form an ad-hoc swarm in order to ask prices in the local area.

5. The Architecture

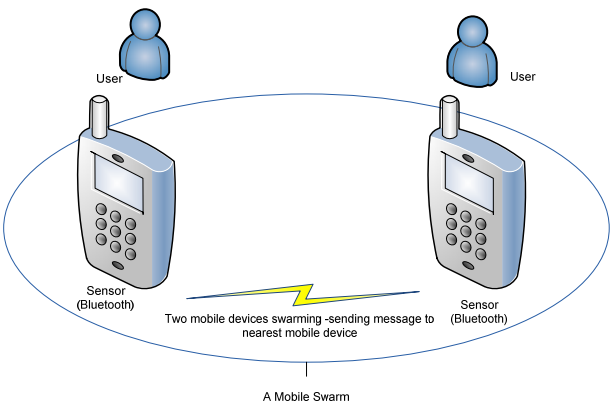

Figure 1: Mobile Phones Swarm Formation for Information Exchange

ISBN: 978-988-19252-1-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

The system works on the principle that the swarm is developed for business. Swarming ability is to form a business, care for information setup that is distributed and able to develop a link for common information requirement. Online systems may take advantage of the internet but such systems are beneficial in developing micro business applications.

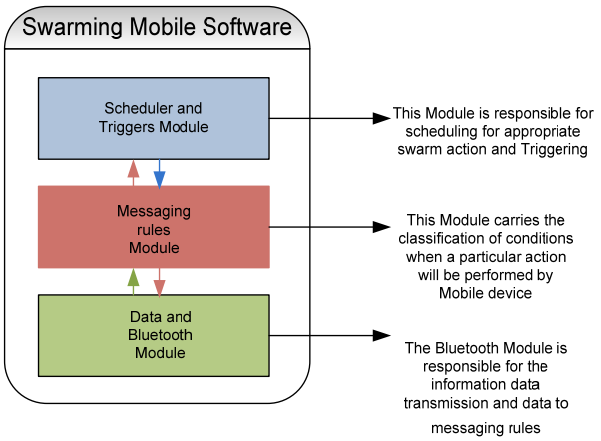

Figure 3: A Mobile Swarming software

Swarming software is responsible for two principle tasks. First to keep check the current context of mobile. In case there is an activity it swarms with the other mobiles. Mobile device makes transition from normal to downgraded / deprived state if the communication system is down. Based upon user condition and response, messaging; rules module starts sending messages to near mobile devices in the range.

5.1 Configuration

The swarming software is composed of three main modules. The data module is responsible for the forming a mobile ad-hoc network among mobile devices. It manages the communication of the swarming mobile module of other devices. The module discovers, connects devices and sends and receives data for software.

The messaging module is responsible for rules and procedures during the operation of software. Every user selects a certain level of threshold when a particular action should be taken by mobile phone. For example one user may select if there is delay of 5 min, the mobile should start swarming, and other user may increase time to 10 minutes setting values for software. The module is responsible for the number of messages, users and size to send to other devices. The scheduler trigger is looking for maintaining a timetable for the mobile to operate, over operation / swarming may exhaust the mobile form resources and under operation may not suitable .

Second, at the state of deprivation of mobile devices, mobile upgrades to higher level of context awareness. This enables the mobile device to collect the data of one or more devices and send it to the available network.

6. FUNCTION

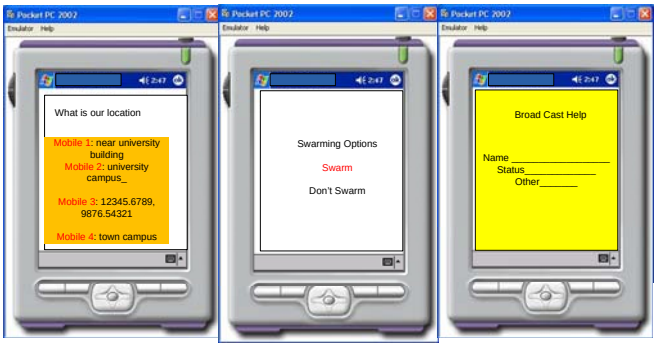

Figure 4: A Mobile swarming to crowdsource

The system achieves following goals

- Self awareness by receiving data from other mobile devices
- Generating information about affected person
- Using human and computational resources for context awareness

The user of the mobile device enters name, location and health information. This message is propagated to rescue agencies, near range mobile devices and restored or fully functional devices in the emergency range. The flow of the information results into stimulating of other devices and the information starts making its presence in environment. In this case the mobile devices are environment and messages are pheromones. When all or most people are rescued there are chances that devices are accompanied with them. The pheromones level starts to decrease when people leave the swarm.

The stigmergic communication of mobiles and collective sending of some devices both are features of swarm intelligence based functioning. Common factor among them is that they require at least two or more mobile devices to start this kind of activity.

7. FUTURE WORK

The system can be used for business applications and related fields. The software will be swarmed for more than two mobile devices .It can upgraded to context aware systems. This concept can be further refined to develop business applications, elderly healthcare, tourist information system, emergency management system and mobile games.

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ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

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