Title of the course: Smartphone Computing & Applications

1. Credit requirement:(L-T-P: 3-0-0, Credit: 3)

2. Please select the committee for Approval: PGPEC

3. Name of the Dept: CSE

4. Please Specify the Level of the Subject: PG level

5. Whether the subject will be offered as compulsory or elective: Elective

6. Prerequisite(s) for the subject, if any
(Please give the subject numbers and names): Not required

7. Course Objective

Mobile computing and networks is a dynamic and emerging field. Smart phones have emerged as truly pervasive and affordable communication, computing as well as sensing platform in last few years. The rapid developments in the smart phone industry, advancements of the social network and network science research, together with the visionary demands for ubiquitous access to information, have introduced new constraints and new opportunities in many areas of mobile networks.

However this development comes at a price, in terms of capacity, quality, security and network complexity. In order to understand the opportunities and limitations of the smartphones, their potential for growth, and how they can cooperate, the proposed course intends to bring the insight and knowledge of the underlying networking technologies, architectures and protocols, as well as principles of mobile computing and its enabling technologies together.

This course introduces the basic terminologies of mobile computing, fundamental concepts of mobile programming environment and its difference with the classical programming practice. This will be followed by more smartphone centric topics such as energy management, localization techniques, location privacy issues, context-awareness and gesture recognition methodologies. Introduction to smart phone based peer-to-peer applications, Mobile social networking are some of the key issues which will constitute the topics for further exploration. Apart from mobility management and data management, the students will also be exposed to emerging topics and advanced mobile applications. In summary, students will learn the principles of smart phone computing and its enabling technologies, and explore a young but rich body of exciting ideas, solutions, and paradigm shifts.

8. Study Materials
In this course, we will use textbooks only for building up the fundamental concepts. However, majority of the topics will be covered through lectures on

important concepts available in the recently published articles, and presentation of the related papers.

Books:
1. Smart Phone and Next Generation Mobile Computing (Morgan Kaufmann Series in Networking), PeiZheng, Lionel Ni
2. Principles Of Mobile Computing, Hansmann, LotharMerk, Martin Niclous, Stober
3. Mobile Computing, Tomasz Imielinski, Springer

9. Syllabus:

1. Introduction [3L]
Challenges in mobile computing, convergence of sensing, computing, and communications, Introduction to smartphones, tablet, PDA, or other digital mobile devices, Introduction to smartphone system architecture.

2. Programming platforms [4L]
Overview of different mobile programming environments, Difference with the classical programming practices, Introduction to mobile operating systems, iOS, Android, Windows, Mobile application development.

3. Wireless Energy Management [3L]
Measurement of energy consumption, WiFi Power Save Mode (PSM), Constant Awake Mode (CAM), Different Sleep States, WiFi Energy management.

4. Localization [4L]
User location and tracking system, Cell tower localization, Spot localization, Logical location, Ambience fingerprinting, War-driving, Localization without war-driving, Indoor localization, Crowd sourcing for localization.

5. Location Privacy [2L]
Different approaches, K-anonymity, CliqueCloak, Location Privacy, Applications with location proof.

6. Context Sensing [3L]
Context-Aware system, Automatic Image Tagging, Safety critical applications (case study: determining driver phone use), Energy-efficient Context Sensing, Contextual Ads and Mobile Apps.

7. Activity and Gesture Recognition [4L]
Machine Recognition of Human Activities, Mobile Phones to Write in Air, Personalized Gesture Recognition, Content Rating, Recognizing Human without Face Recognition, Phone-to-Phone Action Games, Interface design issues, Touchscreen, Gesture-based Input.

8. Mobility [3L]
Overview of Mobility models, Automatic Transit Tracking, Mapping, Arrival Time Prediction, Augmenting Mobile 3G with WiFi, Vehicular WiFi Hotspots, Code Offload

9. Privacy and Security   [2L]
Authentication on Mobile Phones, Activity based Password, Finger Taps usage as Fingerprints

10. Miscellany   [3L]
Cloud-based services, Peer-to-peer applications, Delay-tolerance, Mobile social networking

10. Names of the faculty members of the Department/Centers/School who have the necessary expertise and will be the willing to teach the subject (Minimum two faculty members should be willing to teach the subject)

Bivas Mitra, Niloy Ganguly

11. Do the contents of the subject have an overlap with any other subject offered in the Institute?

Related Subjects offer by the Institute
IT60119   WIRELESS ADHOC & SENSOR NETWORKS
CS60055   UBIQUITOUS COMPUTING
EC60054   MOBILE COMMUNICATIONS AND FADING
EC60106   MOBILE COMPUTING

a)   Approximate percentage of overlap: 5%

b)   Reasons for offering the new subject in spite of the overlap

Smartphones form a unique class of devices requiring new way of application design. They are characterized by limited processing, memory and storage capabilities; mobility across different types of networks (untrusted WiFi hotspots, various cellular data services) that have intermittent connectivity in some cases; a different user interface (touchscreens, gestures, and limited keyboards); and limited battery power. They are multi-function in nature and often come equipped with a large array of sensors — cameras, accelerometers, touch capabilities, GPS, and even electronic compasses. Usage models for these devices are also quite unique with people using them as personal digital assistants, as notetakers, as alarm clocks, as cameras, and sometimes as a mainstream-computing platform.
Realizing the potential of such devices and being able to program upon it would be useful for the graduate students of our institute. Side by side the course would be of tremendous help for researcher scholars working in the area of wireless and mobile computing. This proposed course primarily coversthe capabilities of smartphone and their related application, which has a minimal overlap with the subjects currently offered by the institute.

Related Subjects offer by the Institute

EC600543 Mobile Communication and Fading
Syllabus :
Historical review; Uses of mobile radio-different services; Land, maritime and air services; Relation to navigational systems; Cordless telephones and wireless PABXs; Cellular system and frequency reuse; Analog and digital modulation techniques for mobile radio, signalling, control and connection to fixed network; Multipath and fading channels; Path loss, Diversity techniques; Mobile radio transmitters, receivers and link designing;

Mobile Computing EC60106
Syllabus :
Mobile channel characterization : Fading and shadowing, communication issues, review of cellular schemes, model and methodology, mobile computing topologies, networks and protocols, file system, wiring the campus, mobility management, wireless LAN and data PCS, application frameworks, exploiting mobility commercially, accessing the world wide web, privacy and anonymity.

Comment: The above two courses mostly focus on the physical layer and electronic aspects of the mobile network. However, the proposed course aims at the different aspects of smartphones and wide variety of applications. Syllabus wise, it has a minimal overlap with the proposed one.

IT60119 Subject Name : WIRELESS ADHOC AND SENSOR NETWORKS

Introduction: Basics of wireless networks, Properties of wireless ad hoc networks, types of ad hoc networks, applications .Mobile Ad Hoc Networks: History, properties, medium access control, routing including multicating and broadcasting, mobility models, transport layer issues, congestion and flow control, quality of service, security issues. Wireless Sensor Networks: History, properties, medium access control, routing, energy efficiency, topology management, coverage, congestion and flow control, quality of service, resource allocation, scheduling, security, multimedia transmission, mobile sensor networks, applications. Wireless Mesh Networks: Evolution, medium access control, channel assignment, routing, transport protocols, congestion control, scalability, mobility management, applications. Vehicular Ad Hoc Networks: Introduction, applications and their classification, VANET communication stack, medium access control, routing, security, mobility models, vehicular sensor networks.

Comment: This course mostly covers the wireless network, sensor sensors and basic protocols of the adhoc network. Syllabus wise, there is almost no overlaps with the proposed course.

CS60055 UBIQUITOUS COMPUTING

Overview of wireless technologies, Signal propagation, Multiplexing, Modulation, and Spread spectrum techniques. Media access control: FDMA, TDMA, CDMA. Cellular systems: AMPS, GSM, DECT, UMTS, IMT-2000. CDMA-based cellular systems. Satellite systems: basic routing, localization, and handoff issues. Wireless Networks: packet radio network, Wireless LAN, IEEE 802.11b, Bluetooth, Wireless ATM. Wireless Application Protocol (WAP) and WML. Mobile Networking: Mobile IP, Ad-Hoc Networks: AODV, DSR, DSDV routing. Wireless TCP: indirect TCP, Snooping TCP, Mobile TCP. Information Management, Location-Independent and Location-dependent computing models, Mobile applications and services, Security.

Comment: This course covers different kinds of ubiquitous networks such as wireless networks, adhoc networks, cellular networks, mobile networks. It introduces fundamental properties of all these networks with different protocols associated with this. A small part of the course discusses about the mobile applications with no emphasis on the smartphones (which is the main theme of the proposed course).