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A Survey on Improved Mobile Crowdsensing with Integration of Emerging Technologies

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ABSTRACT

In the wake of the advancement of mobile devices and related technologies, mobile sensing has become an ever-growing and emerging concept. This eminar intends to explore and explain the impact, flow, and processing of data via the interaction of these mobile devices and large numbers of people; hence, it is termed mobile crowd-sensing (MCS). MCS paves the way to explore new monitoring applications in different fields such as social networks, lifestyle, healthcare, and intelligent transportation systems. MCS makes use of sensors such as GPS, etc., and software incorporated within mobile devices such as smart wearables and smartphones based on Android and iOS. These collectively gather (sense and store) data from their surroundings and, depending on the aim of the software, send it to their database for processing or do the same using local resources. The seminar covers the utilisation of mobile sensing at individual and community levels. It discusses the main components of the infrastructure required to support the MCS framework. But with great advancements come greater risks. MCS paves the way for false organisations and individuals to steal, intrude on, and corrupt the data stores of components (which also include people) that are part of the framework. The recent issues in the MCS findings are reviewed, as are the opportunities and challenges in sensing methods. Finally, open research issues and future challenges facing MCS are highlighted.
Keywords: MCS findings, social networks, lifestyle, healthcare, intelligent transportation systems

I. INTRODUCTION

The integration of high processing power, computational intelligence, and sensing devices driven by industrial ideas has enabled mobile devices to reach a maximum number of people, thus resulting in the evolution of the internet of things. In the past, typical IoT devices, which include physical items tagged or embedded with sensors (e.g., chemical containers with temperature sensors, RFID-based technologies), were a few of the only sources of data sensing. Smartphone vendors are continuously increasing the number of built-in sensors, a fact that makes them an excellent contextual information provider. Thus, smartphones can be used for large-scale sensing of the physical world at low cost by leveraging the available sensors on the phones. Eventually, smartphones, similar to static nodes, will be capable of sensing, computing, and communicating. However, the main difference is that smartphones are moving and repositioning themselves in the network all the time. The embedded sensors in mobile phones are leveraged for various sensing tasks for MCS applications of particular interest.

MCS emphasises efficient data collection via a large number of smartphone devices, enabling several significant applications. This activity may be

participatory or oppurtunistic, which fall under the category of community applications of sensing devices [1]. Personal applications such as Google Glass display information in a smartphone-like, hands-free format. Wearers communicate with the Internet via natural language voice commands. Community applications are extensions or bigger versions of such personal or individual examples. Other instances would be Lumen, a handheld device that measures a user's metabolic activity through their breath. Smart wearables such as smart wristwatches, which mainly include fitness trackers, and bands like the Jawbone UP help people understand their sleep cycles, move, and eat better. NuMetrex Fabric Chest Strap is a heart rate-monitoring chest strap with heart-sensing fabric technology and a second-skin fit. It consists of a soft band with heart rate sensors knitted into the fabric. LECHAL GPS Shoes are a pair of Bluetooth-connected shoes that use haptic feedback to notify users which direction to take [2].

With the support of the cloud, data fusion techniques can be applied to the information collected from smartphones. One of the most sophisticated and popular examples is on-demand cab or ride services. With the help of a smartphone application driven by built-in GPS technology, they can see the cabs available within their vicinity, and a single tap lets them book them. A user can also see the cab moving towards their location on the map of the application. Once the cab is booked, the application displays the driver's information. The contact calls only when he has reached the destination. Companies such as Ola make use of data analytics so that they can forecast demand for their services on a daily basis. With the help of large technical remote resources, security, deadlocks, and technical errors are handled, thus converting this participatory MCS application into a thriving business idea [3].

Sensor data can contain sensitive user data from a large number of people. This has increased security concerns and issues for the organisations using the MCS framework. For example, GPS sensor readings can be utilised to infer private information about the individual, such as the routes they take during their daily commutes and home and work locations. On the other hand, these GPS sensor measurements (from daily commutes) shared within a larger community can be used to obtain traffic congestion levels in a given city. Thus, it is important to preserve the security and privacy of an individual while at the same time enabling MCS applications [4].

A popular approach for preserving the privacy of the data is that of anonymization, which removes any identifying information from the sensor data before sharing it with a third party. But the drawback of this method is that it may still be possible to infer frequency-type data from the anonymized data even after using data replacement strategies [1]. So a better idea is that data perturbation-based approaches, which add noise to sensor data before sharing it with the community to preserve the privacy of an individual, are appropriate. The data perturbation approaches rely on adding noise in such a manner that the privacy of an individual is preserved, but at the same time, it is possible to compute the statistics of interest with high accuracy (due to the nature of the noise being added). For highly sensitive data, suppression is used, which deletes the released data partially or completely [4]. However, these techniques can be applied only to at-rest or visible data, i.e., logs, data exports, and web pages.

II. LITERATURE SURVEY

One of the most well-known applications of MCS includes large-scale sensing. This is used mainly in the classification of specified traits, human activities, etc. [6 ml] suggests the Paricle Swarm Optimisation (PSO) technique to search for the best value of k in a k-NN classifier, which minimises the misclassification rate in standard datasets like Iris. However, it did not discuss the dynamics and factors that are present in an environment where human activities are important.

Augmented reality delivers an enhanced experience by combining a real-world environment with computer-generated perceptual information. The authors in [7] suggest a multi-agent simulator technique that consists of human and bot interactions without knowledge of each other's identities for better processing on social platforms. Mobile agents are the key emphasis, as they break barriers to distant communication with virtual agents. This mechanism provides more filtered data to processing centres and therefore has the potential to contribute to smart cities, etc. However, it assumes the completeness of the data, which needs to be considered.

Online education at a particular college may be considered a refined subset of a real-world environment where the integrity of practical data is a significant aspect, unlike a socio-technical platform where data collection from users can show abnormal outliers and behaviors. [8 visualisation] suggests crowd-sensing in such a manner to visualise data for decision-making. It doesn't address the data patterns obtained from unexpected behaviour like teachers' difficulties in lectures or personal problems faced by students that impact their input. Regardless of the above, as data is mostly structured, making modifications later is not a hassle, at least for a small-scale setup.

Traditional edge computing architecture for mobile crowdsensing suggests assigning tasks like data acquisition, etc. to network edges and thus partitioning them according to locations [9]. Edge servers share the burden of processing centres (central servers in traditional MCS). This significantly optimises data filtering before processing, assuming the edge servers to be secure and trustworthy, when in reality most of them are provided by third parties in the case of large networks. [10] assumes semi-honest edge servers with the use of homomorphic encryption, which differs from typical encryption methods in that it allows computation to be performed directly on encrypted data without requiring access to a secret key [11].

The authors in [12] employ blockchain, an extremely secure and decentralised technique that is a far better alternative to centralised servers with limited cons such as infiltration by adversaries, high operation and execution costs, etc. The framework allows users (the crowd) to modify or replace their IDs at any time for each execution of a smart contract to avoid getting tracked.

Connected vehicular cloud computing (CVCC) comprises smart vehicles operating by cooperating with each other in scenarios such as vehicular crowdsensing. Fogs, which are deployed as roadside equipment, have their own processing capabilities and act independently in traditional vehicular crowdsensing, which can lead to attacks, disruptions, etc. [13] suggests vehicular clouds for task assignment under a single trust authority as fogs are equipped with strong algorithms for fake trust value increment detection and maintain tabular structure to store vehicle IDs, their tasks, etc.

III. CONCLUSION

Mobile crowdsensing is a crowdsourcing architecture empowered by efficient data acquisition via mobile sensors and devices. It truly epitomises the rapid growth of mobile technologies and associated concepts.This paper presents the traditional architecture of mobile crowdsensing and how other concepts like machine learning for data filteration, smart contracts for privacy preservation, optimised edge computing for central computing, etc. can counter, if not all at once, time, obvious drawbacks of cloud computing. It also discusses mobile crowdsensing implementations for environments with expected behaviour that are tolerant of specific parameters. It may not be possible to counter all the cons of mobile crowdsensing considering restrictions on computing resources and capital on a large scale. But for a more specific type of environment, it should be.

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