Research Article

Aiming Sustainable Transportation Utilizing Social Capital: A Perspective of Mobile Car Park App

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The mobile car parking (MCP) app provides users to locate a car park and park his/her car, which is expected to contribute to sustainable transportation. Previous mobile phone-based studies have also advocated that mobile apps create a social network among the users. However, MCP studies have yet not addressed the notion of such social capital which is expected to contribute to the sustainable transportation in a city. MCP, in fact, can also create a communication network among car owners, drivers, and car park owners and offer a unique base for studying social capital and resource utilization opportunities. To reduce the gap in existing studies, in this study, an android-based MCP app was developed as a tool to study the components of social capital. After developing the MCP app, two focus group studies were conducted to explore the components an MCP app can provide. Lastly, we linked the social capital components to the sustainable transportation goals. This research pinpointed several social capital components that are addressable to sustainable transportation, including information exchange, communication, connectedness, time-saving capabilities, mobility, coordination, plan-based journeys, and an opportunity to generate income from the social network. Moreover, very few studies have reported that social capital empirically contributes to time-saving capabilities, mobility, sustainable transportation through improved coordination in car parking management, and improved journey based on car parking decisions which are new contributions to social capital. This research is significant, as most of the mobile-based social capital research concentrated on bonding, bridging, and networking among social network members. However, this research has expanded the components of social capital in many directions. Furthermore, from the research methodological perspective, this research adopts a new approach through a combination of experimental research and focus group study.

1. Introduction

The concept of sustainable transportation has been a growing interest as limited parking remains a major problem in most cities around the world. From the cities of Hangzhou [1], Sir Lanka [2], and Berlin [3], there were many similar reports on parking shortages and parking disorders, resulting in traffic congestion. Mobility in cities has become one of the biggest problems in both developing and developed countries [4]. Unsustainable transportation thus causes massive delays on the road, increased fuel wastage, and monetary losses [2]. Moreover, it was reported that traffic jams kill 1.24 million people in the world annually [2, 5]. Despite its strong impact on cities and people's lives, sustainable transportation through organized car parking is often ignored.

Digitalization of car parking using the mobile app is expected to demonstrate some success in providing sustainable transportation through utilizing available but un-utilized car parks in a city [6]. It is obvious that not all private car parks are utilized in a city as the car might not be parked. However, this private car park can be rented through a mobile car park app. Thus, MCP expands the opportunity for more parking in cities and helps to reduce the number of vehicles on the road [7].

In this study, the mobile car parking (MCP) app is a mobile-based system where car parking owners use mobile devices to rent their unused and unutilized car parks for a long- or short-term period to the car drivers and car owners. The definition is derived from Dery and Mac-Cormick [8], and Stieglitz and Brockmann [9] who emphasized mobile system capabilities to share information and perform collaborative work either synchronously or asynchronously with other users. This definition is formulated to accommodate the MCP app as a tool that is expected to assist car parking owners, car owners, and drivers to communicate, exchange information available as social capital, display information, and provide a platform for collaborative work. Like any other mobile phone application (mobile app), the MCP app has positioned itself as an effective tool for building connections among individuals, communities, and even within the global context. Studies purported that the mobile app provides access to information for mass people [10]. The mobile app creates a network in society, and within the network, users have the opportunity to exchange ideas, opinions, and thoughts [11]. This implies that the developed social network using a mobile app is a capital to the users.

The observed benefits of a mobile app have an opportunity to shift the domain to a new paradigm—utilizing social capital and sharing resources. Social connectedness and interaction with social structures by using a mobile app [12] eventually turned the notion to utilize the social capital resources [13]. Following the theme, some recent studies have provided insight into how mobile apps possibly can be used to utilize social capital to bring business values for human benefit [13, 14].

This research aims to explore the components of social capital that are expected to assist in achieving sustainable transportation using an MCP application. To achieve the aim of this research, firstly, a cost-effective MCP application was developed using an experimental method; secondly, a focus group study was employed to pinpoint the components of the social capital using resource sharing of a social network; thirdly, the components were then linked to sustainable transportation goals and subgoals. It is expected that the MCP application will increase the utilization of free and unused car parking in a city, which will provide a sustainable transportation system. In this research, we consider an unutilized car park or an available car park as a social resource for research in the MCP context. However, the following research question thus posits:

> RQ. What are the social capital components that can be achieved using an MCP for sustainable transportation?

2. Literature Review

2.1. Dimensions of Sustainable Transportation.
The concept of sustainable transportation can be derived from the sustainability definition of the Brundtland Commission [15]. Sustainability in transportation is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs [15, 16].

Sustainable transportation emphasizes the need to co-ordinate car parking, reduce traffic congestion, increase vehicle mobility, and reduce accidents. Transportation facilities and activities have significant impacts on sustainability in transportation [16, 17]. The role of sustainable transportation has also been also addressed by the United Nation's (UN) sustainable development goals. Sustainable transportation can enhance economic growth and improve accessibility. Sustainable transport achieves better integration of the economy while respecting the environment, improving social equity, health, the resilience of cities, urban-rural linkages, and productivity of rural areas.

2.2. Concept of Social Capital.
In general, social capital suggests that resources are generated through social relationships. Hence, it is an opportunity for the utilization of such resources that are evolved from social communication, interaction, and companionship [18]. For example, females get mental support from the elderly females of society. Shopkeepers develop social relationships and would be expected to benefit more from membership in larger social networks and increase business sales.

The social capital theory aims to provide a better society through cooperation among the societies, which creates an interrelation among the members of the society [19]. The potential of the theory is that it ensures the benefits and finds a solution for communicating, bonding, networking, social, and economic problems of the social networks which consist of members of the society [20]. Thus, three main distinct aims of social capital are as follows: firstly, bonding—it creates a bond among people within a family, close friends, and other people; secondly, connecting—which links distant friends, coworkers, and teammates; thirdly, linkage—that ties to people or groups further up or lower down in the social pyramid [20].

There is no uniform definition of social capital, as theorists have assessed social capital by different properties. Perhaps, Paldam's [21] viewpoint explained the reasons behind the pluralist definition of social capital. The author purported that the three main proprieties of trust, ease of cooperation, and network resulted from many definitions of social capital. For example, Villalonga-Olives and Kawachi [22] defined social capital as the resources available to individuals and groups through membership in social networks. Networking was also highlighted by Annen [23]; and the author defined social capital as a player's reputation for being cooperative within a social network. However, in this research, we define social capital as a social network and the members of the network exchange information and/or goods among them.

Defining the components of social capital is important in assessing social capital. These components are the elements or benefits that form social capital. Many scholars firmly believe that relations/networks, benefits of the network, trust among the members of the society, and norms are components of social capital. For example, Saukani and Ismail [24] advocated that mutual benefit from a social network is capital and an important component of social capital. Apart

from benefiting, other components of social capital are structural, cognitive, and relational. The structural aspect includes knowledge or intellectual capital and cognitive recognition that exchange within a social context that is both created and sustained through ongoing relationships Nahapiet and Ghoshal [25]. The relational aspect of social capital is concerned with the underlying normative dimensions that guide exchange-related behaviors.

Despite its powerful and intuitive appeal of social capital, it has proven difficult to implement as a social good [20]. Bridging and bonding are important components of social capital for society. However, more considerations, including more elements and factors, are required to explain [26]. Following this observation, this research attempts to expand the components of social capital that are expected to be considered in a social network.

2.3. Mobile App Studies Concentrated on the Use of Social Capital.

Recently, Hillyer [27] studied the impacts of online platforms on transnational families. Connectedness, which is a key component of social capital, is the main benefit provided by information and communication technology (ICT) and social media for transnational families. Online communication with family and friends in Brazil, according to the research participants who migrated to Japan, provides emotional support that aids in acclimating to Japanese society. Recent migrants can also use ICT and social media to meet other people with similar interest and background. Social media also aids solutions to work-related issues and cultural differences and language barriers.

A study conducted by Huang et al. [28] showed how ICT affected a team's social capital and project performance in the construction industry. Their results showed that the mediating effect of bonding on a team's project performance is larger than that of bridging. Managers can develop a compatible information platform for project participants, according to this study.

A study by Zhang et al. [29] explored how social media-enabled customer-firm cocreation could generate commercial value. The purpose of that study was to examine how a social-media-based customer-firm cocreation mechanism, which was conceptualized as the structural, cognitive, and relational dimension of social capital, influenced the first-order knowledge outcome (knowledge transfer effectiveness) and second-order dynamic capability outcome (absorptive capacity) and how these cocreation outcomes ultimately influence organizations. A survey of 149 Chinese mobile app developers was conducted to test the approach. Research has shown that social, structural, cognitive, and relational linkage, particularly structural linkage, are the key cocreation strategies for improving organizational performance. In this cocreation mechanism-outcome-performance framework, knowledge transfer effectiveness and absorptive capacity have strong mediating impacts. The moderating effects of social media usage level on the links between cocreation mechanisms and outcomes are also widely supported. By shedding light on social-media-based customer-firm cocreation in new product

development at a process level, the study contributes to theory and practice.

Salehi et al. [30] looked at a variety of digital social programs that were used to increase social capital. The programs varied from digitally enhanced self-help or self-guided treatment (to improve people's self-efficacy) to group therapy and web-based caregiver support services. Mobile social applications, video blogging, video communication systems/videoconferencing, and online social communication, as well as more sophisticated approaches like virtual reality, were among them. Individuals' social connection has improved health by using the application. Two aspects of social capital were achieved: cognitive social capital, which focuses on improving trust and control, as well as self-efficacy; structural social capital, which focuses on an individual's ties with family/careers, friends, and peers, as well as other macrolevel connections like healthcare providers and their community.

Sun et al. [31] created and deployed a system called *Movement*, which aimed to raise local community awareness through shared location traces. To present aggregation, community-level location data movement safely uses anonymized location data supplied automatically by mobile devices. Residents in Bronx and New York City participated in the deployment of movement over 6 weeks, according to the authors, used anonymous data to make judgments about individuals and locations in their community, but chose to reveal their identity in third-party settings where they may be connected socially.

Cho [14] investigated the connections between smartphone app use, social capital, and social isolation. The authors examined the effects of two separate smartphone apps, communication, and social networking site (SNS) apps, on social capital bonding and bridging. The use of smartphones by different generations was also considered. The usage of communication apps by individuals was found to be beneficial for generating social capital, with the effect of utilizing communication apps being stronger among the millennial generation than among older users. Furthermore, bonding and bridging social capital were found to dramatically lessen people's social isolation.

Schrock [13] looked at the relationship between Facebook and the expansion of users' social worlds. The study looked at how mobile media affected Facebook social capital results among parents with young children. The study used a group of people who were heavy users of mobile media and needed social support. An online survey of parents with young children ($N = 262$) offered a generally positive impression. The results revealed a distinction between Facebook usage on a desktop and a mobile device. Multimedia activities with social linkages gathered bridging capital toward a contextual understanding of the impact of visual media. In turn, social capital was linked to mobile Facebook activities that were good for parents' well-being.

2.4. Mobile Parking App Studies.

Recently, Kabir et al. [32] offered a solution to address car parking challenges by implementing an automated car parking allocation system.

The system incorporated Web 4.0 technology and the Internet of Things (IoT). The system offers automatic parking lot allocation, position monitoring, parking management, real-time invoice creation, and a payment system. Another IoT-based smart car parking allocation was developed by Peyal et al. [33] for metropolitan areas. The system links the photoresistors to a mobile app for data transmission. The method is anticipated to minimize on-road traffic congestion and better use the driver and passengers' time.

Alkhuraiji [34] built and implemented an Android Smart Parking Mobile Application. Their goal was to make it easier for university employees to reserve a parking spot in advance. The system functioned by assigning a number to each parking spot and connecting them with an infrared sensor. A parking space has a unique number, and it is indicated whether the space is available or not. The research showed that the available parking spots were efficiently managed, and it was hoped to be expanded to include other regions and venues.

Apart from using IoT-based car parking allocation, the MCP applications have also been built using Open StreetMap (OSM), Google Maps, and technologies like Global System for Android-Based MCP. For example, Bakheet et al. [35] applied an android mapping application using OSM. The main objective was to determine the user's location on the map during an emergency and to display the map while offline. Although the application utilized the powerful features of OSM, it was institutional-oriented. Another Android parking application was introduced by Promy and Islam [36] where people could rent out their private places as parking places. This is an effective and versatile solution for overpopulated places to stop illegal parking. However, mapping application or navigation in maps was not mentioned in both papers.

Kocsány et al., [37] focused on a self-parking system that alternated between using bird's eye view maps and community-built maps like Open Street Map. A parking lot search subsystem for a self-ruling parking system may use those maps differently. The usage of preinstalled sensors in parking lots becomes obsolete when an extra environmental sensor is mounted on a car, making automatic parking space allocation reasonable. Imbugwa et al. [38] also created an MCP using an open-source parking management system.

To reduce traffic congestion during the process of parking place searching, an Android prototype of a vehicle parking system S-park was introduced by Kate et al. [39]. In that work, proximity sensors placed in the parking places periodically send signals to the server, which are received by drivers who are in the quest for parking places.

Lin et al. [40] study conducted a literature review on MCP apps. The analysis brought out some of the system's problems and unresolved concerns. The research offered a thorough examination as well as an interdisciplinary outlook. Furthermore, the key findings of the existing state-of-the-art provide suggestions for future smart city and Internet architecture studies.

Srisura et al. [41] developed a mobile autoparking application to help drivers find parking spots. The study's app was created based on user preferences for appropriate materials and input from relevant stakeholders.

Banti et al. [42] developed a roadside automobile parking application that used the mobile crowd-sensing paradigm. The study emphasized some specific solutions that were primarily related to the efficient parking assignment process, data quality and integrity, energy efficiency, security and privacy, and incentive provisioning.

A deep learning-based method was utilized to discover appropriate parking places nearby in Iqbal et al. [43]. The technology transfers data to a central database through data capturing units which mobile app customers might access and use to schedule their parking spots. All information was saved in real-time and accessible via the smartphone app. A vehicle categorization system with 77% efficiency for several vehicle types has also been developed. Furthermore, a number plate recognition technology has been employed to detect and maintain parking site safety measures. Another recent study by Navarro-B et al. [3] used data from car-sharing park-out incidents and a machine learning system. Based on the machine learning approach, the study reported that 91.6% accidents occur due to shortage of car park sharing opportunity.

3. Research Gaps

Even though a few studies by Salehi et al. [30], Hillyer [27]; Zhang et al. [29]; Huang et al. [28]; Sun et al. [31]; Cho [14]; Schrock [13] explored that there is a positive relationship between a mobile app and social capital, not many MCP aimed to investigate the impact of MCP on social capital and resource utilization. Thus, there is a connection required between the MCP and social resource utilization. Studies on MCP should investigate to answer how free car parking allocation systems can be used to increase social capital and resource sharing using MCP? This forms the main gap in MCP.

The literature review on mobile phone-based social capital research suggests that most of the past research has focused on only one facet of social capital (bonding), rather than looking at social capital more broadly. Salehi et al. [30] also supported our observation and suggested that digital social capitals have a lot of potential for establishing further social routes to access supportive services.

Lastly, most car parking apps concentrate on the technical perspective rather than the societal and national perspective such as sustainable transportation. However, societal aspects should also be incorporated to the technical perspective for accpetnce of the technology in a given society. For any IT innovation including a mobile app, it is a general expectation of how the innovation enables social values for the betterment of society and cocreates value between users and social resources.

4. Research Methodology

This research adopted a qualitative methodology which is appropriate for studying human behavior and complex IT systems, considering the surrounding social and business contexts [44]. It is also a suitable framework when there is a need for explorative research to explore inter-related phenomena [45]. Mobile apps are a complex phenomenon such

as the use of an app's dynamic socio-technical process. This approach is also applicable for realizing organizational functions (such as a mobile car parking app needs an organizational context) and cultural phenomena. Our qualitative approach explores car parking allocation processes, structure, and stakeholders' engagement according to the study guidelines by Leue et al. [46].

From qualitative methodology, an experimental study and two focus groups study were conducted to explore how an MCP app can contribute to sustainable transportation. The following two sections describe the justification and process of qualitative methodology.

4.1. Experimental Study. An experimental study is a description and analysis of what will happen or what will occur under carefully controlled conditions [47]. The experimental technique is a scientific approach that may be used to examine anything new [48]. For experimentation, to deliver a meaningful solution to a problem, an experiment must fulfill three fundamental and interconnected conditions: control, randomization, and replication. However, an experiment must evaluate the requirements of the experimental objectives. In this research, the experimental objectives are studied using a focus group. However, the experimental approach focuses on the components of social capital through the voice of car owners and car parking owners. In Section 4.2, we describe the processes of developing an MCP prototype.

4.2. Focus Group Study. The focus group study aims to investigate the components of social capital offered by the MCP. A focus group is advisable when existing knowledge of a subject is unfamiliar and inadequate [49]. However, two focus groups were developed, one is the car owners/drivers, and one was the car parking owners who want to rent their car park.

4.2.1. Selecting the Members of the Focus Group. Focus group participants were selected purposefully, based on their insights, experiences, and thoughts [50]. The car parking owners and car owners for the focus group were chosen by the researchers who would then request them to provide their education, experience, and expertise.

The researchers collected information about the cities where most of the traffic congestion occurs due to more vehicles than available car parks. The information was collected from Bangladesh Road and Transport Authority (BRTA) officials, local newspapers, and students from various districts. Finally, respondents from the area *Kadirgong, Rajshahi, Basundhara, Gulshan, and Baridhara* agreed and were selected as focus group members. The researchers communicated with participants individually, building a rapport with them. Informal discussion helped the researchers know if the member of the participants was appropriate for the selected focus group.

Each of the focus groups included 10 members. The number was chosen not only because they would give enough information for the study but also because the numbers were manageable. Moreover, setting them up was not bedeviled by any logistical problems. Tables 1 and 2 summarize the focus group participant details.

4.2.2. Focus Group Discussion Instruments and Pretest of Instruments. In both focus group studies, a semistructured instrument was used. The questions were tested with a small group (3 members) before the actual focus group study. The three members were selected from a university teacher of English, a socio-technical researcher from a government institute, and a car parking owner. The members were chosen from the own contact of the primary researcher. The researchers wanted to check if any questions were ambiguous to the participants and make sure questions captured the required phenomenon and identify the questions that produced the most useful spread of information as a way of standardizing the questions.

4.2.3. Focus Group Discussion Process. The semistructured interview approach guided the focus group without limiting discussion and allowed participants to express themselves openly in their own words. The questions did not have any prescribed answers and thus could explore the issue widely. Some of the information was unexpected. Utilizing a semistructured instrument provided flexibility to the researchers to add new questions where necessary to clarify any issues. Participants provided a versatile array of information in both focus groups [49]. However, after the answer received from the participants, closed questions were asked to make their position and responses more accurate [50]. The following questions, in brief, were included in the semistructured question:

> Please tell us about your job.
>
> Tell us about the parking system in the city.
>
> What do you do with the unutilized car park?
>
> Do you think you have a better idea to utilize the unutilized car park?
>
> Do you have a mobile phone? Are you familiar with the mobile car park app?
>
> How an MCP can improve your job as a driver?
>
> Do you think you will rent your car park using MCP?
>
> What are the main advantages of MCP from your point?

After the final selection of the participants, the researcher introduced himself and briefed them about the research. Yin [50] advised spending some time with participants before starting the interview. This is particularly true in Bangladesh where social conversation and interaction help to build rapport. These informal conversations made the participants more at ease and better aware of the research. The researcher made phone calls to each of the focus group participants after the final selection of the group. Moreover, the researcher answered any questions of the participants to establish clarity. When the participants were

TABLE 1: Focus group participants on car owners and drivers and their details.

Participant's code	Description	Job responsibility	Experience (years)
CDO1	Student of KUET, department of EEE	Drives fathers-in-law car occasionally	3+
CDO2	Housewife		5+
CDO3	Businessman	To go to his office	7+
CDO4	Teacher at university	Goes to his campus and for a random visit	10+
CDO5	The personal driver of a doctor	Goes to his chamber	12+
CDO6	Uber driver	Goes to Uber for rent	4+
CDO7	Retired govt. officer	Visit friends and family and goes out shopping.	15+
CDO8	Rent a car owner	Having a car rental business	20+
CDO9	Software engineer	Go to the office and go to shopping or visit relatives.	4+
CDO10	Businessman	Having 2 cars, one for his personal use and another for his family use	10+

TABLE 2: Focus group participants on car parking owner and their details.

Participant's code	Area	Description of car parking space	Experience (years)
CPO1	Kadirgong (rajshahi)	The rich family has two car parks and one idle boy. Therefore, it could be an income source for the boy.	7+
CPO2	Basundhara	Uber driver and do not need his unutilized parking space in the daytime	18+
CPO3	Basundhara	It is a corporate zone after the afternoon this parking space is free	8+
CPO4	Basundhara	Do not have a car but his flat has one parking allocated for his personal use	6+
CPO5	Gulshan	During office time, his parking space is free	6+
CPO6	Gulshan	It is an office, but at night, the entire zone is free	10+
CPO7	Gulshan	Having one unused parking space a day	7+
CPO8	Gulshan	During office time, the personal car parking space is free	4+
CPO9	Baridhara	Purchased 2 flats with having 2 parking spaces but have no car	6+
CPO10	Baridhara	Having a 2-parking space. One is always unutilized.	6+

confident, they were informed about the venue and the time of the discussion. The venue was carefully selected where privacy was afforded and where the participants were not preoccupied [50]. In this case, the venue was a booked hotel. Before the focus group started, the participants were briefed about the research. All members were given background information about the research. A consent form that highlighted the research policy, interview, recording procedures, privacy of the participants, and complaints was provided. The participants were encouraged to read the consent form and to ask any questions they had. Once all participants expressed their understanding and accepted to take part in the focus group, they were asked to sign the consent forms. Then, the actual interview started. The focus group session was two hours long. The questions prepared earlier by the researcher were used to go deeper into the discursive structures that frame the world of mobile-based car parking in Bangladesh. The discussion was open and uninhibited; the researcher asked a question and encouraged the participants to answer.

A focus group has different dynamics than the other counterparts of qualitative studies such as interviews and discussion. In this research, the researcher managed the dynamics of the focus group, and the researcher played a nonjudgmental [49, 50] role.

A focus group provides the consensus on a topic. It jogs the person's memory. However, group thinking can be a problem if participants hesitate to express their views. There is a precaution that focus groups may provide superficial information if participants do not involve in indepth discussion as interaction is the central part of the focus group as suggested by Powel Single [49]. The responses were audio-recorded with their permission. The researcher also noted nonverbal responses such as body language and facial expressions as these can provide an important aspect to research [50]. At the end of the interview, the participants were given the contact details of the researcher and the research supervisor in case the participants wanted to contact for any reason.

5. Description of Experiments

The experimental approach for developing an MCP was executed by firstly defining the requirements of the MCP. Secondly, developing a high accurate prototype after defining the requirements of the MCP. The system is depicted in Figure 1. The following sections describe the process of development:

5.1. App Development Lifecycle.
A customized Agile Scrum methodology is adopted in this research in developing the MCP app. The Agile Scrum method is sprint-based. Its selection of use is based on flexibility and adaptability during
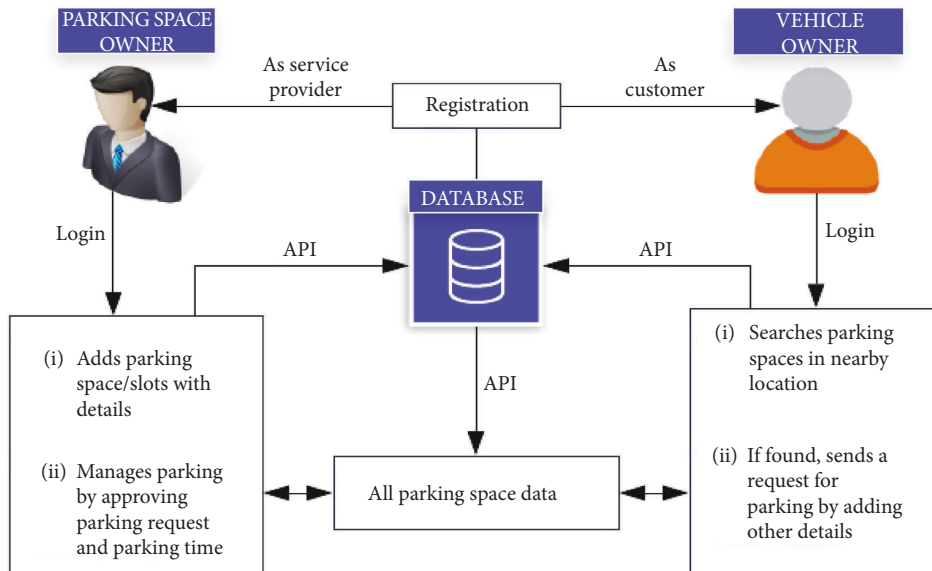
FIGURE 1: System diagram.

development, creativity, and innovation of ideas, and better quality improvement of the final product [51].

5.2. Usability Goals and User Experience Goals. To develop a prototype that addresses the problem, we define suited usability goals and user experience goals for MCP. The usability goals defined are as follows: make the user interface (UI) simple and design-oriented navigation, make the apps responsive to multiple UIS, reduce users' short-term memory demand, and provide control to the users in using the app.

5.3. Challenges Faced in MCP App Development. Before starting the development, it is highly crucial to realize the challenges to develop a mobile app. The main challenges that we faced in developing the MCP are the variance of hardware utilities, rapid version release of the software development kit SDK environment, the presence of various manufacturers of Android such as AliOS, Baidu Yi, ColorOS, EMUI, Fire OS, Funtouch OS, MIUI, One UI, OxygenOS, and realmeUI, and screen size of the android devices.

5.4. Description of the MCP App Workflow. The MCP app requires user registration and user login to the system for using the application. There are two user roles, namely, one for admin and one for users. The admin manages the back end of the application and approves the user and parking add requests. They will manage the user and parking-related data and other needful to run the application successfully.

A user has two roles: one for the car parking owner to add parking as the owner of the parking and one for the user to book parking. Based on the availability of parking, the user can park a car in the parking place and collect the ticket for payment. The parking availability is managed by the

server itself. It keeps track of the remaining parking at that location. Figure 2 describes the process.

5.5. Core Technologies. The front end of the MCP is written in Java, and the view is in XML. The Android front end keeps continuous communication with the backend application that is written in raw PHP, and the database is written in MySQL. The prototype is developed in Android using Android Software Development Kit (SDK) 23 [52] connected to a MySQL 8.0 database [53] to save and retrieve data with the help of a PHP 7.3 API (PHP Group, 2021). There are also some third-party services used to add good value to the application. The development was carried out in the Android Studio [54], which supported both a compiler and an emulator for the application.

5.6. Third-Party Services. The third-party services used in the development of MCP in this research are listed in Table 3.

5.7. User Interface. The layouts of the user interface design are supported by XML with the help of Android Studio. The screenshots of some of the different user interfaces of the MCP with descriptions are given. Upon starting the MCP app, there is a screen for login for an existing user or a sign-up screen if a user wants to register. The following menus are included in the system (see Table 4).

The user interface and the menus of the system are provided in Figures 3 and 4.

6. Focus Group Data Coding and Results

Thematic analysis was selected as a means of data coding for the focus group study using NVivo, as it assisted to reveal and explaining the social capital components of an MCP. The focus group members informed the following social
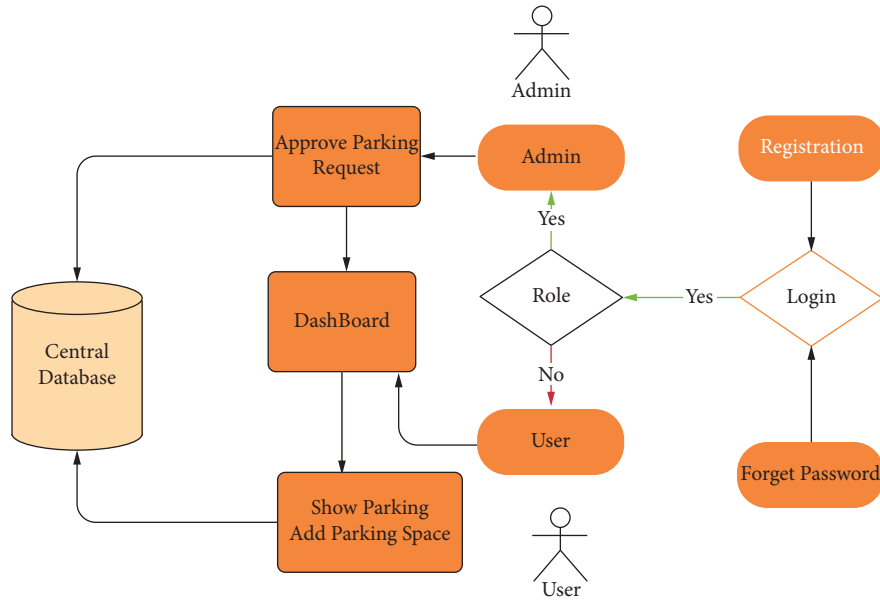
FIGURE 2: Flowchart of the system.

TABLE 3: Third-party services used in the development of MCP.

Third-party services	Descriptions
OSMDroid	Used to give all of the open street map functionalities to the android application replacing android's map view class [55]
OSMbonuspack	Used to enhance the capabilities of OSMDroid [56]
MapQuest	Used to implement navigation on maps [57]
Circleimageview	Used to create circular images for decorative purposes [58]
Sweetalertdialogue	Used to create alert dialogues [59]
Picasso	Used to enable image caching and downloading [60]
BubbleTabBar	Used to create a bottom navigation bar with customized bubble-like tabs [61]
OKhttp	Used to recover from common connection problems with response caching, load faster, and save bandwidth [62]

TABLE 4: Menu of the system.

| Menu	Description of the menu
Splash	This is the landing page of the application as Figure 3(a)
Login	From the login, the module user can log in to the system with a specific username and password as in Figure 3(c)
Registration	For being a user of the solution one user can register with the system. The information that is to be provided for registration is name, e-mail, phone, and password. Figure 3(d) represents the registration page.
Dashboard	According to the user role and the dashboard, menu could be varied. Some menu items are available for admin users, and some of them are accessible to other users. See Figure 3(e).
Add parking	Users can add (see Figure 3(f) parking through this app. On the map, the user can drop a pin and add details about the parking location.
Approve parking	When a user requests a parking location, the admin user approves the parking location as Figure 3(i). Without approval, the location will not be available in the MAP.
Find location	From the find location menu, the user can find a suitable location using the built-in navigation system as Figure 4(a).
Dial, park here, and navigation	From this app, users can dial and communicate with the parking owner
Navigation	From navigation, users can find the turn-by-turn navigation. They could reach the parking location with this awesome navigation. See Figure 4(b).
Park here	From the park here menu, users can park their vehicle there, and then when the process is done, a ticket is generated from the system.
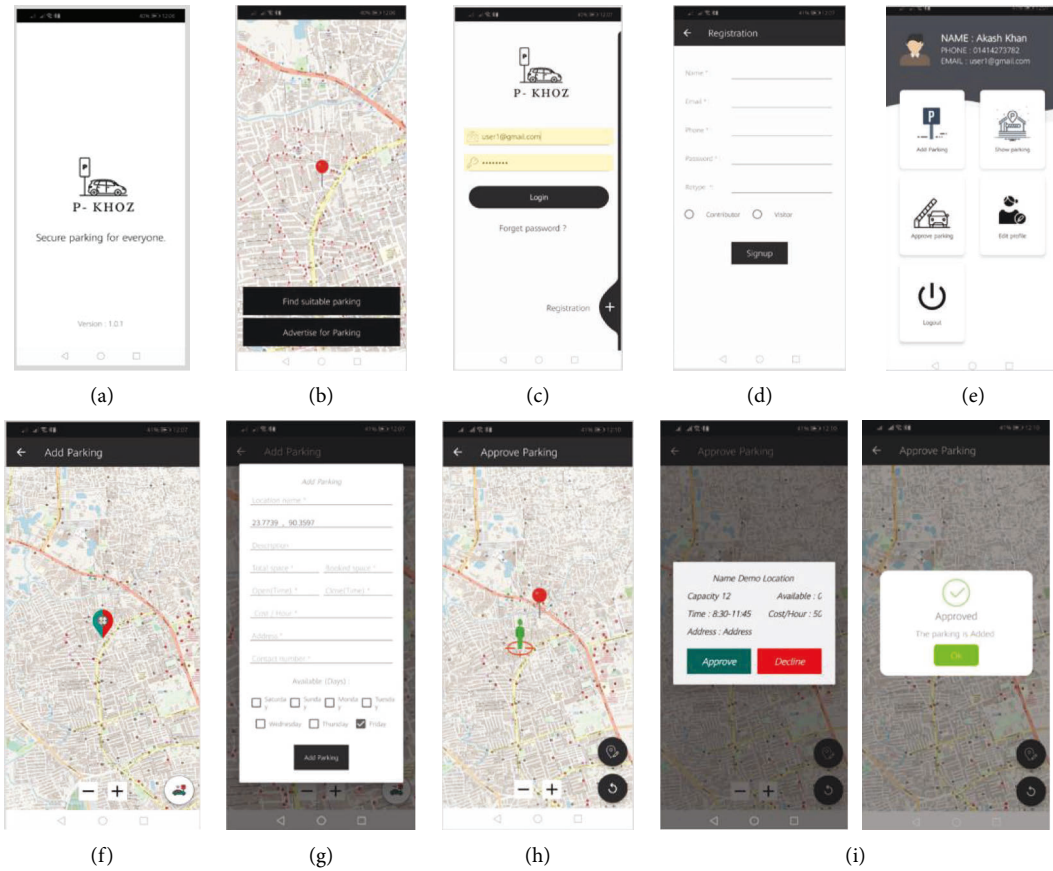
FIGURE 3: Car park owner menu of the MCP. (a) Splash. (b) Landing. (c) Login. (d) Registration. (e) Dashboard. (f) Add parking. (g) Parking form. (h) Pending parking. (i) Approve/decline.
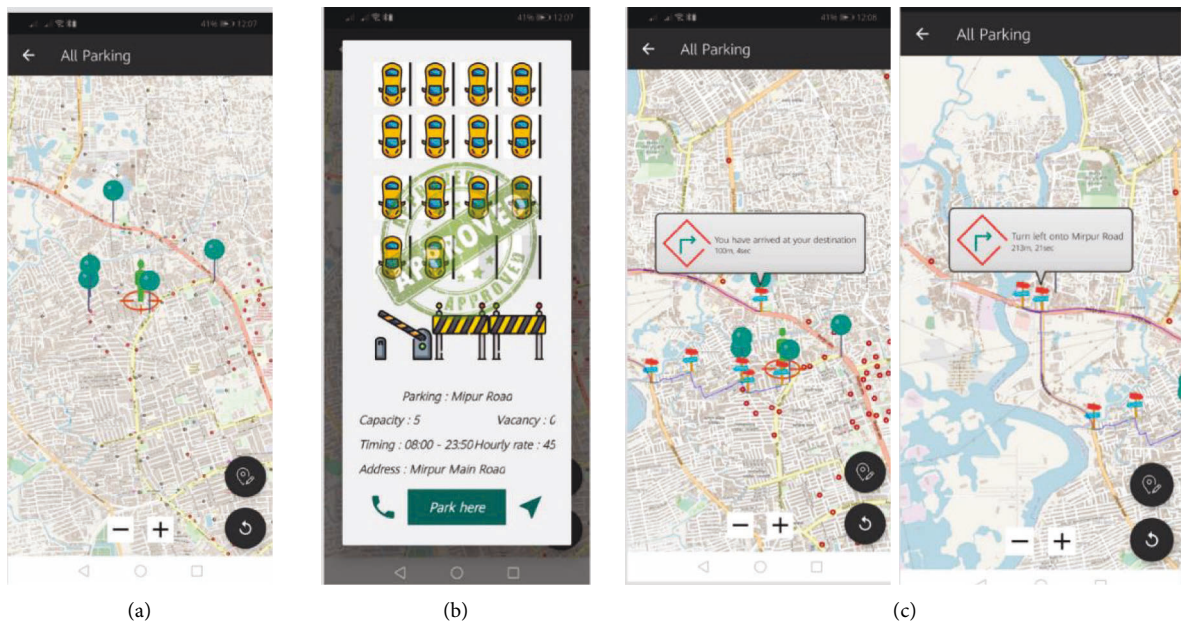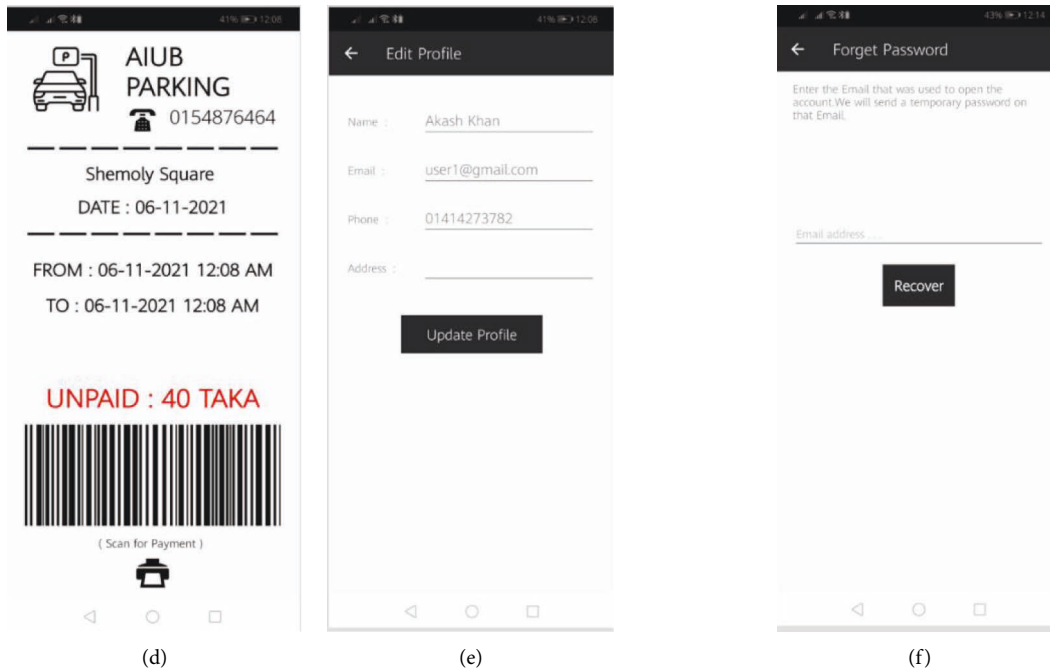

FIGURE 4: Continued.

Figure 4: Car driver menu of the MCP. (a) Show parking. (b) Parking details. (c) Turn by turn navigation. (d) Parking ticket. (e) Edit profile. (f) Forget password.

capital components that an MCP contributes to the social capital as well as sustainable transportation.

6.1. Access to Information.
All focus group participants confirmed that access to information is the main offer of the MCP. Access to information was found essential to car drivers, car owners, and car parking owners. A car owner, who is a businessman, emphasized the importance of access to information by commenting on this particular point:

> "..my town is a small and complex city. . .. Even compared to the car number. As a businessman I need to travel. . ...there are golis (small streets) where you cannot take your car. Therefore, I need information on where I can park my car: (CO3).

This particular outcome utilizes an MCP-based social capital utilizing resources drawn from Ahad et al. [10] and Edelman et al. [26]. Edelman et al. [26] earlier also indicated that a positive force for accessing information is also supported by mobile apps.

6.2. Improved Communication.
All research participants confirmed strongly that MCP has the potential to contribute to communication development. CD1 made his comment on this point by

> As a driver, when I drive my father-in-law's car, I have found some difficulties in car parking . . . . So this app will help me in communicating with the car park owners.

6.3. Connectedness.
The ability to connect to a car parking location using MCP creates significant value for car drivers and car parking owners. A carte n in charge of a multistorey building who is also responsible for renting the available car parking of the building (CPO2) suggested the following:

> . . . Though my main responsibility is to manage the ...(owner) flat, you know, some flat owners do not have a car. They continuously pressure me to find a car renter. How can I do that?. I am not that much a mobile expert. However, as you said, if car owners can find my location, I can connect them to the owners. This system will make my life easier as car owners can connect to my location.

Another car owner added the following comments, based on his job scenario:

> My boss (car owner) and their family members go here and there but they do not realize that Dhaka city has limited parking. I cannot say anything. If I park the car on the road, the police give us mama (a fine). MCP will allow me connecting a nearby car park location.

6.4. Contribution to Time-Saving Capabilities.
MCP will save time for the car owners and car drivers. A car driver (CD4) commented on this topic:

> . . .. As you know I am a busy driver as I need to drive for Sir (car owner), the madam (wife of the car owner) takes their children to school and returns. I need to bring the car back home and drive again to the destination. This mobile

system (MCP) will let me know the nearby car parking, I can save time and fuel.

And another related comment by the car owner:

. . .. The system will allow car parking information in my thumb. I will not be dependable on my driver anymore. You know, I need information about where the car can be kept safe.

6.5. Increased Mobility.
Focus group participants CD3, CO6, CD10, and car parking owners such as CPO2, CPO4, and CPO9 commented that an organized car parking system in Dhaka city will decrease traffic jams by increasing the mobility of the vehicles. In some comments, we explore how MCP can support mobility:

As a driver, I need to move the car here and there most of the time. . . . . but if I have a car parking space, I can keep the car off-road and many other cars will be parked. It will increase mobility as fewer cars (moving without reason) on the road (CD10).

A car owner (CO6) also supported CD10 by commenting like that

. . . . . .when I call my driver and he informs me he is not there (where I was left). . .. He is half a kilometer away. It makes me immobile. . . . . . if he gives (provides information) me a nearby car parking, I can be much more mobile.

6.6. Access to Information.
Coordination of car parking is important for any city. A focus group participant explored by commenting

. . . . .city requires improved car parking. . . . . . .but what can you do, there is no place for car parking. . . . . .the system will assist the authority as you will find a lot of cars are parked and roads will be free of cars are not required to travel

In this scenario, one general manager (CPO and CO) suggested how MCP could assist in improving car parking coordination:

If MCP is implemented . . . .drivers will organize their cars. . . . . . . .and the parking system will be organized.

6.7. Decision-Based Journey.
The decision-making process will also improve, as the scenario was supported by car parking owners and car owners:

. . .usually, we (car drivers) do not have a prior decision when we start a journey. . . . . . we do not know how much we have to move for a parking spot. . . . . .our journey can be more smooth if we know where to park the car.

6.8. Improved Coordination in Car Parking Management.
MCP is an opportunity to use ideal car parking and generate income. A car parking owner (CPO7) commented on this particular point:

. . .. see as I am a retired person and I bought an apartment in Bashundhara with car parking but because of having no car, I do not use it. If I can rent this, I will make an income source for myself... Even as you said, if the money (car parking rent) comes from mobile payment, it will increase the car parking renting process.

6.9. A Formal Agreement with Nearby Car Parking Renters.
MCP can be a means for owners as an official channel to enter into formal agreements with organizations requiring long-term car parking. A car parking owner commented.

. . .we have car parking for rent . . .we can rent it for a long term. . .but we need a third party who can organize this agreement. . .. Like property-related websites.

6.10. Reduction of Fuel Cost.
Interestingly, if the drivers cannot find the car park, they return to the car owner's home. This causes twice the journey and twice the fuel cost of the actual journey. CDO5 commented on his experience:

As I need to take my boss (doctor) from one hospital to another hospital, it is impossible to park. I then return home and wait for his call. . . . . .(for the next destination). . . . .it is a double work. . . .costing my boss extra cost for fuel, I realize it.

6.11. Improved Health.
The consequence of long hours of work as a private car driver is also exposed by the CDO8 by commenting

We work long long hours. . . .. taking boss (car owner) from here and there . . . .other family members for maybe shopping. . . however most o the place do not have a car parking. More (time) you drive on the road, causes damage to your health and increases the chance of an accident. . . if we have a place we can park the road we can take a rest.

7. Discussion

This research pinpointed access to information, improved communication, connectedness, the contribution of time-saving capabilities, increased mobility, and improved coordination are some beneficial components of social capital in the context of MCP. The components are derived through empirical evidence based on focus group data. The outcomes of this research are presented in Table 5.

In a discussion on social capital about economic performance, Annen [23] claimed that the relationship between social capital and economic performance is ambiguous. Contradicting Annen [23], this study empirically evidenced

TABLE 5: Social capital findings of this study.

Social capital components	Type of the components	Outcomes	Link to sustainability
Access to information	Structural	Helps to find a parking location	Goal 11: sustainable cities and communities
Improved communication	Structural	Connect directly with the top management	Goal 11: sustainable cities and communities
Connectedness	Relational	Build connection	Goal 11: sustainable cities and communities
Contribution to time-savings capabilities	Effect of the relational components	Able to take the smart decision	Goal 9: industry, innovation, and infrastructure
Increased mobility	Relational	Decrease traffic jam	Goal 9: industry, innovation, and infrastructure
Improved coordination in car parking management	Governance	Build strong bonding	Goal 9: industry, innovation, and infrastructure
Improved journey based on car parking decision	Cognitive	Increase usability and reliability of the system	Goal 9: industry, innovation, and infrastructure
Increased income	Monetary	Increase car parking renting process	Goal 8: promote employment
A formal agreement with nearby car parking renters	Structural	Build communication channel	Goal 8.3: encourage the formalization
Reduction of fuel cost	Monetary		Goal 12: global resource efficiency in consumption
Improved health	Good health and well being		Goal 3: good health and well being

that despite bonding, networking, or bridging, the cooperation in a social network is also enhanced by the economic value of social capital. Tangible and intangible resources reside on a social network, and the members have an opportunity to utilize and increase the economic performance of the social network.

By nature, mobile apps are IT artifacts that can overcome time, context, and space barriers and establish communication among users. The influence of the connectivity of MCP on the building as a component of social capital extends the findings by Shi et al. [63] and Huang et al. [28] that indicated that ICT connectivity can anonymous members of the society, thereby increasing communication efficiency. Communication requires to be higher in developing sustainable social networks [23]. Connectedness is the accompaniment of social capital through its inclusive network, which is also supported by Ahad [64] and Ahad et al. [11].

A community can solve problems by itself; however, the hierarchical division impedes solving the problems. However, the finding that improved coordination in car parking management is a component of social capital aligns with the concept of Bowles and Gintis's [65] study, which supports that community governance is a component of social capital. The authors argued that the individual residing in the social capital is motivated in supporting community governance, which is often not captured in the studies. Good governance is a complement of social capital, and this research empirically finds that utilizing a car park as a social resource community is expected to be beneficial through an organized car parking system in the country. Our findings support Helliwell et al. [66] found that there are empirical linkages between good governance and

national well-being. The time-saving capability of the drivers using MCP is supported by Ahad et al. [10] and Baron and Gomez [67].

The modernization of transportation has revolutionized the landscape of civilizations around the world. Realizing the fact that the UN has placed sustainable transport at the heart of the SDGs (UN 2022), the focus group data suggest, among the seventeen goals, SDG 3 on health (increased road safety), SDG 7 on energy, SDG 8 on decent work and economic growth, SDG 9 on resilient infrastructure, SDG 11 on sustainable cities (access to transport and expanded public transport), SDG 12 on sustainable consumption and production (ending fossil fuel subsidies), and SDG 17 can be linked directly or indirectly linked to sustainable transportation.

A careful review suggests that technology and science are directly or indirectly related to the SDGs. It is agreed that the problems that sustainability science needs to solve are defined by society, not by scientists, so the stakeholders in society must be involved in solving the problems. However, using the social capital network, the MCP app is expected to achieve the components for sustainable transportation documented in Figure 5.

8. Contribution of This Research

The contributions of this research are discussed.

8.1. Theoretical Contribution. There is a call for investigating the theoretical link between mobile apps and the sociocultural milieu [68]. Chatterjee et al. [69] noted that mobile-based apps are reluctant to use societal theory and lack
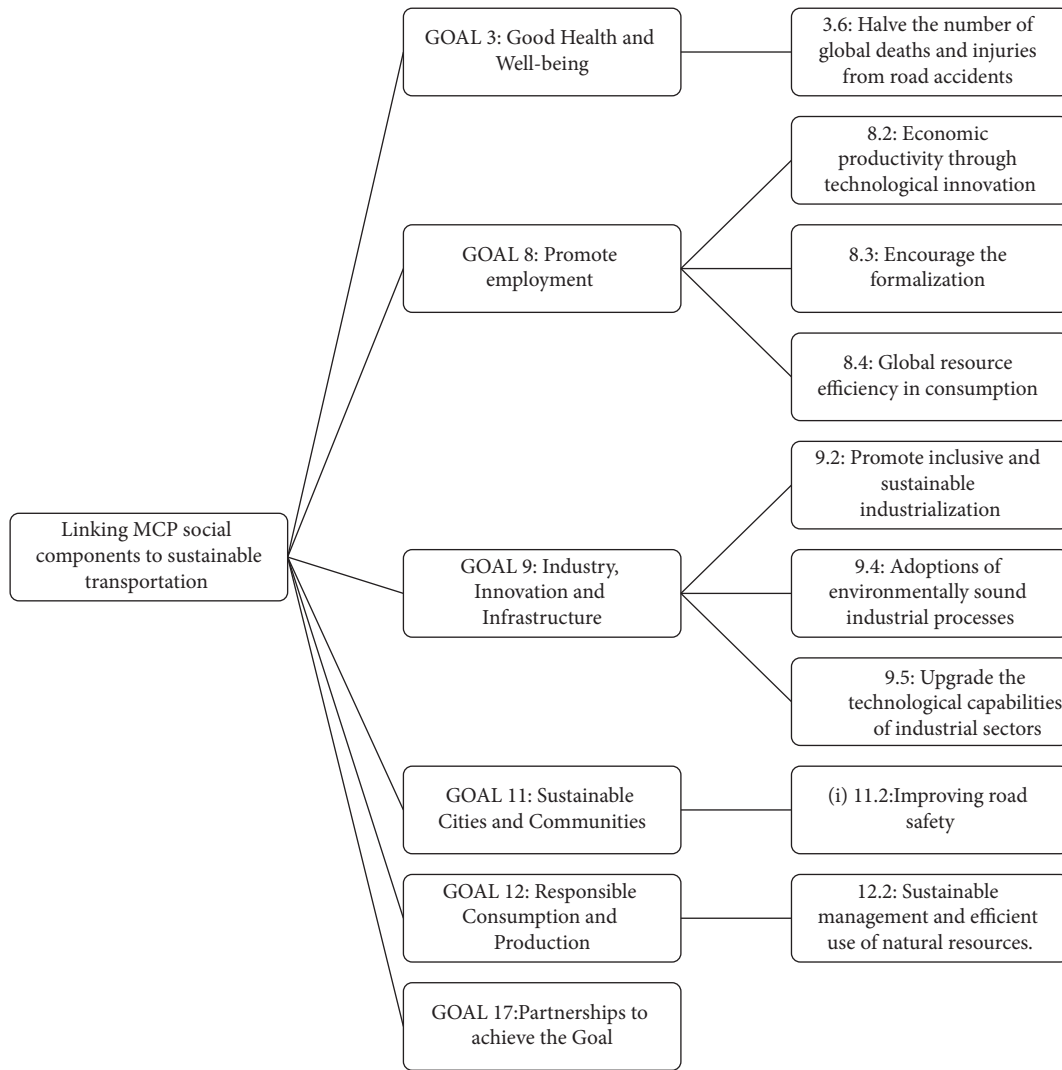
Figure 5: Social network components link to the SDGs.

coherence and solidity until theoretical breakthroughs were made. The literature research undertaken in this study acknowledges that the car parking apps were not supported by theoretical foundations [34, 40–42]. A technological discussion is not enough to highlight a service, even users will not adopt a service when a service is available. However, theoretical foundations justify the usage, identifying its enabling role.

The study focuses on the development of midrange theory. Gregor [70] defines the midrange theory as a moderately abstract theory that has a narrow scope and may readily lead to testable hypotheses. The midrange theory has been noted as important as the midrange theory deals with practice-based disciplines, especially in social science [71], and it is also noted that the social phenomenon consists of social relations and practices are the root of technology.

8.2. Methodological Contributions. Barki et al. [72] emphasize that researchers should focus on methodological advancement as there were insufficient guidelines to

construct the creation of the research studies. Following these ideas, this research provides a well-documented research journey outlining the choice of base theory, the social capital theory, the justifications of the qualitative methodology, and an experimental approach.

8.3. Practical and National Implications. The number of cars is increasing gradually; however, the number of parking places in cities remains inadequate. The researchers, therefore, identified that it is essential to overcome the challenges of utilizing MCP. Moreover, the authors of [41] mentioned that there are a few mobile parking applications that support the car driver to find an available parking slot. This research also supports Kabir et al. [32] and Peyal et al. [33] from Bangladesh that a megacity like Dhaka city requires a cost-effective parking solution. Income earning opportunities for car park owners, sophisticated car parking opportunities for car owners, and improved city car parking systems are some compliments highlighted of social capital utilization in this research. For the IT industry, we have

provided a pathway to how a cost-effective MCP app can be developed using an open-source platform.

Another national-level implication is that the MCP also sheds light on the sustainable goals (SDGs) set by the United Nations. A close observation suggests that there are technological implications in achieving the targets of the SDGs. Earlier Kate et al. [73] also advocated sustainability research is linked to science and technology. However, the MCP app presented in this research is expected to reduce and deliver. Goal 3: good health and well-being; goal 11.2: improving road safety; Goal 3.6: halve the number of global deaths and injuries from road traffic accidents; goal 9.2: promote inclusive and sustainable industrialization.

9. Limitations of This Study

Since MCP was not live when participants were interviewed, their lack of previous practical knowledge was a limitation in this study. This has been somewhat mitigated though by including appropriate and knowledgeable interview participants; however, as the MCP system was not ready to use when the study was conducted, the opportunities and possibilities identified here need to be tested. The enabling roles are interviewees' perceptions; therefore, the opportunities should be quantitatively tested. Also, the data are the participants' own beliefs and perceptions of experiences; therefore, these are perceptions, not facts. To generate a valid result, this research included confirmatory questions seeking confirmation of conflicting facts. However, analysis of this data displays similarity across interviewee responses, suggesting a level of consistency and credibility in their views.

10. Conclusion and Future Work

This research for the first time, expanded the horizon of social capital using an MCP app, whereas previous mobile app studies mainly concentrated on bonding among the social members, facilitating communication, and following information in the social network. This study supports that the MCP app is effective in utilizing social capital and resources and creates a social path to improve good governance, increased mobility, and income generation capabilities, which were rarely identified in previous mobile app studies. This research pinpointed good governance, increased mobility, and income generation capabilities, which were rarely identified in the previous mobile-based systems. The focus group participants suggested that MCP will provide access to car parking services and will bridge between pathway owners and car parking owners, those who are usually isolated.

The role of MCP in achieving benefits concerning social capital presented in this research provides a basis for future research. These findings of social capital components require further evaluation and testing. It is important to quantitatively validate the components and their perceived relationships. Future research could unearth more social capital components that offer mobile-based services, including MCP. Finally, the social components identified in this

research can be tested in different disciplines and contexts (such as mobile-based shopping or real estate) to test the findings of this research, which will further progress and validate this contribution to knowledge and practice [74, 75].

Data Availability

This research conducted a focus-group study; hence, no data are available except interview transcripts.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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