

# Residual Mobilities: Infrastructural Displacement and Post-Colonial Computing in Bangladesh

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## ABSTRACT

This paper explores discrepancies between the founding assumptions of mobile and ubiquitous computing in the western world, and the starkly different experiences of mobility and infrastructure to be found in many post-colonial environments. Based on a field study of forced mobility and technology use among populations displaced by the Hatirjheel waterfront development project in Dhaka, Bangladesh, we make two basic arguments. First, we point to the partial nature of assumptions around mobility that frame the imagination of mainstream HCI research, and argue that different and heretofore *residual* experiences of mobility must also be accounted for in post-colonial and other marginal computing environments. Second, we document four forms of infrastructural experience – dispossession, reconstitution, collaboration, and repair – that characterize real-world engagements with infrastructure in such settings. We conclude with implications for HCI research and design, and reflections on how HCI researchers might better account for such experiences in their work.

## Author Keywords

Mobility; infrastructure; ethnography; development; post-colonial computing; ICTD; Bangladesh.

## ACM Classification Keywords

H. 1. 2. Human Factors

## INTRODUCTION

Like other sub-fields of HCI work, mobile and ubiquitous computing research is structured around assumptions. Some of these concern the technological conditions and resources available to designers, researchers, and users: stable and reliable power supplies, affordable and ubiquitous cell coverage, effective regimes of privacy and security, and most generally, technical infrastructures that simply ‘work.’

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Others concern the nature and experience of mobility itself, the situations from which it arises, and the kinds of actors who engage it. The modal subject of mobile computing is very often the empowered user, engaging strategically and creatively with emerging tools and systems to support new forms of mobility in their lives (or conversely, to overcome problems that mobilities voluntarily entered into create). From the standpoint of history and social science, this represents a classically liberal figure, endowed with rights, autonomy, resources, and the freedom to act and choose, including around the spatial circumstances of their lives. In this view, mobilities are, on balance, a Good Thing, and our job as HCI researchers is to find new and creative ways to support them.

In many post-colonial and economically marginal environments, however, neither of these assumptions – around infrastructure or around the liberal model of mobility – hold true. Power grids may fail or fluctuate, networks may operate sporadically (and sometimes not at all), and devices and systems of all kinds and levels may break. Even where operative, access to crucial infrastructures may be restricted by barriers of cost, literacy, availability, or social or economic standing. Nor are the conditions of mobility always as voluntary or choice-based as the liberal model would suggest. Rural-to-urban migration driven by economic need is one of the oldest themes and concerns in the development studies field [7,32] and has accelerated throughout the postwar modernization and structural adjustment eras (aided in many instances by regressive state and donor policies that have effectively hollowed out the countryside) [32]. Efforts at modernization, from dams and resettlement schemes to urban prestige projects, have displaced countless others, producing conditions of mobility that severely challenge or destroy the assumptions of the liberal model. Still others are displaced by the conditions of war and conflict: a 2013 United Nations report estimated the global population displaced by conflict, persecution, or generalized violence at 51.2 million – a figure higher than at any time since the conclusion of World War II [37].

These differences help frame the divide between HCI research attuned to the conditions of ‘developing’ regions (whether under the label of ‘ICTD,’ ‘post-colonial computing,’ ‘computing at the margins,’ etc.) and the unmarked categories of tool- or topically-framed fields of HCI work. While in developed countries, researchers are

trying to incorporate affect, passion, persuasion, and other sophisticated services through smartphones, HCI researchers in post-colonial computing environments attempt to extend the reach of low-cost networks [10], build interfaces for illiterate people [21,28], and extend access to farming knowledge through agricultural support networks [23]. While mobile computing in developed parts of the world is helping users choose restaurants, music driving routes, or friends on the fly, mobile phones in developing countries are being directed towards fundamental needs and barriers around education, financial transactions, and basic health care. While ‘northern’ innovations in mobile computing may be focused around novel developments in hardware, software, and user interfaces, more significant and original innovations in post-colonial computing environments may be found around practices of hacking, repurposing and repair. These differences point to important contextual differences that shape and separate categories of HCI work and concern as practiced differentially across geographic and social contexts around the world. Properly acknowledged, they should also challenge and extend our core notions of infrastructure and innovation itself.

But mobile computing may also encode unrecognized assumptions around experiences of mobility that it studies and designs for. Where much HCI work in this space assumes voluntary and choice-based movement (as captured in the old Nortel Networks slogan, “Where Do You Want to Go Today?”) our paper calls HCI attention to the problem of *residual mobilities*: the varied forms of involuntary migration, displacement and disruption that characterize the real-world experience of mobility for a large and growing number of people around the world – both in historically post-colonial contexts like the one studied here, but also marginal locations and experiences in what Suchman has termed the “hyperdeveloped world” [30]. Inspired by Star and Bowker’s work on residual categories, and the way in which dominant systems of knowledge and assumption may render important categories of experience marginal or unthinkable, we introduce the notion of *residual mobilities* as a way of gathering and acknowledging experiences of mobility and technology use that depart, sometimes dramatically, from the choice-based assumptions of the liberal model. We argue that better attention to these forms of mobility can help combat limiting assumptions embedded in the liberal model; open new HCI insight into the often creative practices by which poor and marginal populations engage key tools and infrastructures (including computational ones); and open up new terrains for HCI impact and design.

Our claims are grounded in ethnographic fieldwork with a low-income community of approximately 1500 people in the South Begunbari neighborhood of Dhaka, Bangladesh, situated near the country’s largest waterfront beautification and infrastructure development, the Hatirjheel project. The residents of Begunbari are mostly migrants from other parts of the country, and have in many instances been evicted

several other times from temporary settlements and/or districts moved to make way for other commercial or public development projects. At the time of our fieldwork in spring and summer 2014, they were under threat of eviction yet again: in the second week of June 2014, the first round of bulldozers arrived to make space for the road-widening and hotel-construction projects designed to take advantage of the lake’s restored natural beauty. Subsequent phases of the project will involve further eviction of Begunbari residents, including for a planned boundary wall that will limit local residents access to the project’s newly developed park lands and infrastructure.

Building on interviews and participant observation with Begunbari residents, this paper pursues two basic goals. First, we seek to map one instance of the condition of residual mobility: where it comes from, how it’s experienced, and how it torques and limits (rather than frees and empowers) the lives of the people who encounter it. Second, we demonstrate how people made residual under mainstream assumptions of development and infrastructure nevertheless engage strategically and creatively with the infrastructures around them, building new modes of access, support, and value. This kind of creative re-appropriation of infrastructure, we argue, is a central and underappreciated dynamic in many post-colonial and marginal computing environments, and one that HCI scholarship dedicated to other places and concerns can also learn from.

We open with a review of relevant literature in postcolonial and mobile computing, before turning to HCI and social science theories that can help us unpack the nature of mobilities and infrastructures encountered here. We then report ethnographic data around the forms of residual mobility encountered in the lives of Begunbari residents, and describe key features of our participants’ interactions with technology and infrastructure. We conclude with implications for HCI research and design, and reflections on how HCI researchers might better account for such experiences in their work.

## **BACKGROUND AND RELATED WORK**

From its earliest days, mobile computing has been built around and enshrined a basic (and we will argue *partial*) concept of mobility, its social role and desirability, and the potential role of new computational tools in supporting that. Mark Weiser, often regarded as the father of ubiquitous computing, dreamt of omnipresent and seamless computing tools and platforms that would follow and support users through a rapidly expanding mobile life. This dream – and much subsequent ubicomp work - was based on important assumptions: ubiquitous and robust core infrastructures, empowered and competent users, etc. More subtly but no less centrally, it rested on the assumption that users were in charge of their own mobility, able to enter into conditions of movement or flow on the basis of choice and desire, and able to dictate (more or less) the terms and conditions of mobility entered into – in part by adopting tools and

technologies that could support or augment these choices. These assumptions worked well enough (though never perfectly) under the infrastructures, user bases, and liberal democratic and economic conditions of the ‘global north’ (a term of art that increasingly incorporates the wealthier sectors, locations, and peoples of ‘southern’ locations). In subsequent years, mobile and ubiquitous computing has flourished in the western world, proliferating an ever more imaginative range of supportive and interactive services delivered through mobile phones, tablets, wearables, and other increasingly ubiquitous devices and infrastructures.

As mobile technologies started to travel to the developing world, however, many of these basic assumptions were upset. Despite the rapid and widespread uptake of mobile phones in developing countries, important gaps and limits remained. Electricity did not reach everywhere in many developing countries, and power supplies were not stable [16]. Cellular networks rapidly blanketed urban areas, but coverage in rural and poorer regions lagged [1]. Price continued to be an important barrier to access (in particular for the higher end smart phones that northern mobile computing researchers have traditionally relied on) [25]. Digital or basic literacies posed additional barriers to use and adoption [21], and carrying and using an expensive technical device on the streets was unsafe in some contexts, and culturally frowned on in others [1]. The sum of these differences made mobile computing as practiced in many post-colonial contexts a significantly different enterprise than the better-studied forms of mobile computing characterizing ‘northern’ computing environments.

These absences and discrepancies have been called out most forcefully in recent HCI work around the nature and limits of post-colonial computing. Pointing out the infrastructural, cultural, and political differences that shape the entry of HCI tools and assumptions into post-colonial contexts, Irani et. al. [12] pointed to a series of *other* effects that the introduction of new computational tools, including those oriented to ‘developmental’ ends, might have. Computational development and reliance might further troubling and long-standing patterns of north-south dependency. The traditional ‘gap’ or ‘lack’ framing of post-colonial problems around technology might further problematic ‘developmentalist’ discourses that take northern conditions as the implicit goal or marker of economic and social achievement. Basic assumptions around infrastructure and development ‘failures’ may reflect the perspectives of northern actors and institutions, and generate new rounds of ‘development projects’ that fail to engage post-colonial conditions and experiences (though they may be good at sustaining the institutional machinery of the development industry). And western-centered assumptions might blind HCI researchers to what’s *different* about post-colonial computing experience, ignoring sites of action and value – for example, more collaborative forms of technical agency and action [4], or the presence of robust and innovative repair networks [13]–

that may differ in *positive* ways from northern computational experience. At the broadest level, HCI work on post-colonial computing has revealed the extent to which core ideas, expectations and assumptions around computing may reflect conditions and experiences specific to the ‘global North,’ many of which translate badly or not at all to a wider set of contemporary global realities.

Separate lines of work in sociology, geography, and urban studies have begun to open up the nature and experience of mobility itself as a complex and socially distributed space. While this work has pointed to mobility as an increasingly central and formative feature of social life (arguing in effect that societies not only *have* mobilities, they *are* mobilities), it has also pointed to extreme variations in the kinds and outcomes of mobility that members of the contemporary world practice and experience. John Urry [35] for example, has shown how the ‘free’ mobilities experienced through corporeal or imaginative travel in tours, games, and communication media may differ from – and are sometimes predicated on – the no-less-modern mobilities of migration, military movement, and displacement. Saskia Sassen [27] has called attention to the growing prevalence of physical and economic expulsion and displacement as central engines of economic growth and recovery. Earlier work by British geographer Doreen Massey [20] has demonstrated how the ‘power-geometry’ of time-space compression attached to experiences of globalization in the 1990s offered different experiences of mobilities to different social groups. These differences were defined not so much by the *fact* of mobility – both global business executives and economic refugees are mobile, after all – as by the *degree of control over the flows and movements that shape one’s life*. As Massey argues,

“Different groups have distinct relationships to this anyway differentiated mobility: some people are more in charge of it than others; some initiate flows and movements, other don’t; some are more on the receiving end of it than others; some are effectively imprisoned by it”. [20]

If differences in ‘power-geometry’ account for different experiences of mobility in the world, they also help to explain *what* and *whose* experiences are summoned easily to mind when we tell generic cultural stories about mobility (and by extension, build tools and infrastructures to support them). To have your category of experience excluded, and thus to be left out of the story and programs of design and action that build on them, is to be rendered, in Star and Bowker’s term, “residual” [29].

These issues of power and residuality connect in turn to a growing body of HCI and social science work on infrastructure: roughly, the systems of physical and social support that enable, sustain, limit, and give shape to human action in the world. This includes large physical structures like road, water, electricity, and telecommunication networks. But it also includes the people, culture, and

economic and social conditions that also shape the pattern and possibilities of mobility in a society. Historically, there is an essential bias in the growth of infrastructures in the uneven political landscape of developing countries. Graham and Marvin [8] have documented the emergence of new enclave networks that link privileged users of high-end infrastructures in urban areas around the globe. Larkin [17] has shown how infrastructure development in post-colonial contexts may be directed not only to technical and material purposes, but also important “performative” goals, symbolizing forms of power, control, and modernizing and/or globalizing aspiration. These studies point to the important distributional element of infrastructure, and how new infrastructure projects may be caught up in and help to reinforce unequal power relations at the local and national levels. They also suggest the existence and significance of residual mobilities, and the need to account for the distinct needs and experiences of marginal populations in our global or technical accounts of infrastructure development.

Our arguments in this paper draw on data collected through observation and interviews in South Begunbari, a marginal and low-income neighborhood in central Dhaka. Most residents of the neighborhood are migrants from other parts of the country, and have undergone numerous previous experiences of eviction, driven by development projects and/or economic or environmental need. Such forced mobilities have produced profound and challenging experiences of infrastructural displacement and uncertainty. Through processes of innovation, collaboration, and struggle, they have also built new and often creative engagements with infrastructure that have gone some distance to restoring lost services and supports. We argue that these forms of infrastructural engagement – dispossession, reconstitution, collaboration and repair – can offer theory- and design-relevant insights to HCI, and uncover important holes and opportunities in the field.

### **MODERNIZING DHAKA: DEVELOPMENT, DISPLACEMENT, AND RESIDUAL MOBILITIES**

The urbanization of Bangladesh is interlinked with the development of Dhaka City, which has developed as the politico-administrative center of the country. Due to the concentration of both domestic and foreign investment, Dhaka has experienced massive migration from the rural areas of Bangladesh. In the last 60 years, driven by domestic and foreign investment and substantial flows of rural-to-urban migration, the population of Dhaka has increased 35 times, making it one of the world’s largest and by far the most densely-populated city (ahead of such places as Sao Paolo, Delhi, London and New York) [19]. This growth has stressed or overwhelmed the city’s basic infrastructures. Due to rapid urbanization and a lack of effective planning, unplanned settlements have proliferated, many in the form of slum and squatter settlements just like other developing cities as discussed in Hardoy et al [9]. Due to acute demand and high land prices, especially in the

central zones and in upper class residential areas, the slums and squatter communities have moved in recent years towards the city peripheries in search of cheaper shelter, though many of the work opportunities in the informal and service economies remain concentrated in the commercial and wealthier residential districts of the city center [19]. A significant portion of the city’s population lives in these slums and squatter settlements under extremely low living standards, low productivity and unemployment [34]. Because of different development projects and their associated settlements, these people are often evicted and forced to find new places to live. Paul reported the repeated experience (and constant fear) of eviction as a central challenge facing the urban poor in Dhaka, and an ongoing source of uncertainty and precariousness that undermined both general well-being and the ability to plan and organize one’s life around the kinds of long-term choices and investments (education, stable employment, etc.) that might support roads out of social and economic marginality [22]. As our work below will make clear, fear of eviction was a socio-economic but also *infrastructural* concern: to be evicted was to lose not only one’s dwelling, but also access to the place-based and often informal systems, services and supports that make life under conditions of urban poverty sustainable, meaningful, and sometimes good.

The community we studied is in Tejgaon, the largest industrial area of Dhaka city. Our more immediate study site of South Begunbari is surrounded by biscuit factories, metal workshops, car parts and repair shops, gas stations, truck garages, and electronic repair shops. Most residents of the community were low-literate and low-income, and worked in local factories and workshops, ran small informal businesses (tea shops, food stands, etc.), or worked as servants or occasional laborers in nearby wealthier neighborhoods. Almost all had faced multiple episodes of displacement in their life. Most had migrated from other parts of the country and had moved several times (often through eviction) within Dhaka itself. Many were under threat of eviction yet again due to the nearby Hatirjheel waterfront development project, widely hailed as one of the largest and most important Government-led modernization efforts in Dhaka in recent decades.

The Government-initiated Hatirjheel waterfront development project was launched in 2009 with the goal of beautifying the area and reducing Dhaka’s notorious traffic jams by connecting important roads through bridges and widening key feeder arteries. Other objectives included rainwater retention, flood prevention, and improvement of the urban sewer system. While one side of the lake was connected to one of the city’s richest neighborhoods (Gulshan, which was not affected by the project), other parts of the lakeside were occupied by low-income communities and illegal settlements. Their eviction was argued to be necessary for the beautification of the lake and purification of the lake water. Initial land acquisition and settlement removal took two years, and construction work

on the bridges was completed in January 2013, with road-widening efforts (and associated evictions) continuing through the present. The project has been widely celebrated in media and tourist literatures, and the Government featured the project as an exemplary instance of modernization and urban renewal in its reelection campaign of 2014. On the other hand, the eviction process caused a massive displacement of people who used to live around Hatirjheel Lake, many of whom were dispersed to nearby Begunbari or other peripheral areas around the city.

We conducted fieldwork, interviews, and participant observation with the residents of Begunbari area. The first two authors of this paper are Bangladeshi citizens and residents, and one of them worked with the people of Begunbari for 17 months (between March 2013 and July of 2014) to construct modular and portable housing units for the displaced urban poor. Our understanding and access to the community builds largely on this extended relationship. Our participants included men and women who were evicted because of the Hatirjheel project, and others who have been migrated or forcefully displaced from other locations for a variety of other reasons. During this period of time, we observed their living conditions, social interaction places like local streets, market places, tea stalls, connecting lanes, etc. conducted interviews, took part in conversations, and took copious notes and photographs. This resulted in 200 pages of field reports and more than 300 photographs. We also conducted separate semi-structured interviews with 39 local residents, including shopkeepers, part-time domestic helpers, construction workers, rickshawpullers, garments factory workers, metal workshop laborers, vegetable vendors, etc., about the changes in their life and the role of technology in it. The interviews followed general thematic templates that were applied flexibly to accommodate informant stories and lines of concern, together with emergent issues arising in the context of interaction (per common interpretive interview techniques). These interviews ranged from 10 minutes (when interrupted by business, weather or household duties) to 2 hours, with most lasting 45 minutes to 1 hour. Bangla speaking members of the research team translated and transcribed all interviews, and developed a series of descriptive biographies across a representative range of participants. Transcripts, field notes, and biographies were reviewed by all members of the study team, analyzed and coded following grounded theory principles, and used to guide subsequent data and field collection efforts.

#### **HATIRJHEEL AND ITS CONSEQUENCES: INFRASTRUCTURE AND RESIDUALITY**

Before the Hatirjheel evictions began, Begunbari was full of single-storied bamboo and wooden structures, most built illegally on privately owned or government lands, including a variety of structures built on stilts out over the lake itself. During phase one of the eviction process, Government forces took possession of the lakeside areas, destroyed the

settlements with bulldozers, and forcibly removed all illegal dwellers from the area. Per frequent eviction practice in Bangladesh and other places, these steps were taken without compensation or relocation support, and sometimes little or no prior warning. Some residents displaced in these first round evictions left Begunbari and moved to other parts of the city; others shifted to adjacent portions of the same locality, also known as South Begunbari. This produced a sudden population explosion in the area, and caused a rapid shortage and densification of housing. People started to extend dwellings vertically by building 2 or 3 storied structures from wood and bamboo (participants in our study included local residents who participated in this boom as planners, carpenters, and casual laborers). Living conditions rapidly deteriorated. Housing lacked proper light and ventilation. Kitchens were dark, and the toilets were damp. The lanes between houses were narrow and muddy, and as dwellings went higher and the population increased, increasingly dark and crowded. After the construction of the bridge in Hatirjheel, Begunbari received access (in principle) to a variety of improved infrastructures which the area lacked before: well-connected road networks; water, gas, and electrical lines; satellite TV connections; etc. However, these systems included few taps or connection points available to local populations: for the most part these infrastructures ran through Begunbari without materially serving it. Government officials and private land-owners in the neighborhood justified the lack of local infrastructural investment on the grounds that most current residents were there illegally, and the entire area was likely to be redeveloped again in the next few years anyway.

Lacking infrastructural connections, Begunbari residents developed their own. Neighborhood residents built informal circulation paths to connect the community with the new government built main roads. They devised systems of plastic piping to connect households to the new water mains running past the neighborhood, and in some cases underground pipelines to connect toilets with nearby sewer mains. Some residents found ways of running lines of cooking gas to their kitchen (though many continued to burn wood or paper for cooking), either themselves or by hiring local plumbers, carpenters and handymen to complete the work.

One of the most sought after commodities in Begunbari was cheap or free electricity: almost as soon as legal supply lines were installed on poles lining the new government roads, local residents and electricians began the process of tapping and redirecting this power into Begunbari. At the household level, this was accomplished through cheap wires running through and between buildings, occasionally supported on bamboo poles. Local electricians often took responsibility for tapping the main lines (an inherently dangerous process) and for keeping this messy and failure-prone network in more or less functional form. As they reported, heavy use loads and hacked connections often

caused discontinuous flow, load shedding, and fluctuations in voltage. Daily power shutdowns lasting an hour or two were regular features of Begunbari life, and often occurred two to three times per day. These hacking activities also often met with resistance. Government officials periodically came to check the lines, alternately cutting off connections or negotiating with local residents for bribes. In some cases, residents of nearby neighborhoods negatively affected by the hacks would complain (or sometimes disconnecting the illegal lines themselves). As one such resident described,

*“We have always used only one light and fan for our room. But 3 or 4 months ago, we noticed an abnormal leap in our electricity bill. We paid for that month. In the next month the bill raised further up. We sensed something wrong and then discovered the illegal connections that Begunbari people made to my lines. I immediately called the electrician and disconnected them.”*



**Figure 1. Community built lanes (left), and Water lines (right)**

Similar challenges attended the neighborhood’s hacked water and sewage networks. Broken or leaky pipes periodically disrupted water flow and quality, resulting in service outages and contamination of water supplies. Where breakages could be identified they were fixed, often by wrapping pipes with duct tape. In some cases, kludged networks were abandoned altogether, and residents resorted to nearby tube wells or neighborhood stores selling cheap water. Sewage blockages were similarly common, resulting in frequent and occasionally prolonged outages.

The brief account above suggests a number of important characteristics of the relationship between residual mobility and core modern infrastructures like water, power, and road systems. As we saw, the mainstream and formal infrastructures transecting Begunbari were not built with local residents in mind; indeed, the only access to them provided came from the illegal taps and informal hacks that local residents were able to work out. Because of the inherent difficulty and messiness of this work however the quality of services received was often poor and subject to repeated breakdown and disruption (though they remained for all that far better than what residents had access to before). Finally, because of their hacked and illegal nature,

when core infrastructures did fail, residents were left to perform maintenance and repair on their own, either individually or through community efforts (as with the committee of neighborhood electricians charged with building and maintaining power supplies in the area). The combination of these features characterizes the complex relationship between residuality and infrastructure (both formal and informal) in Begunbari today.

### **ENGAGING INFRASTRUCTURE**

Beyond these challenges in securing and maintaining access to basic services, residual mobilities offer an uncertain, interrupted, and challenged relationship with infrastructure and technology more generally. Stretching from uncertainties around the availability and quality of technical services to the ongoing challenge of maintaining and fixing what services they have, conditions of residuality frame different modes of technical experience and engagement than those commonly addressed in HCI scholarship. In the sections that follow we explore four of these: dispossession, reconstitution, collaboration, and repair.

#### *i) Dispossession:*

Dispossession of infrastructural support is a common experience in residual mobilities. Beyond their many other effects, experiences of eviction and migration detach people from key sources of material and social support. Participants in our study had recently undergone or were about to undergo exactly such processes. The uncertainty, risks, and short and long term social and economic effects of dispossession constituted an important aspect of their engagement with infrastructure.

Dispossession through eviction is often uncertain and sudden, affording little time for planning or adjustment. Notices of impending evictions are often short or non-existent. For example, one of our participants was evicted with her family from a previous dwelling at the Moghbazar Railway Slum two years ago with a one-day notice. At Moghbazar they had access to an illegal electricity line, which they used to run a couple of electric bulbs and fans, a television, a mobile phone, and a radio. After being evicted they spent five nights in the open, sleeping on roadsides, used candles and streetlights for light, and cooking on fires made from waste paper. They were also in constant fear of being moved at any time by the local Police. At that time they had no access to electricity, and hence were totally detached from all sorts of technical services. Other participants undergoing similar episodes reported keeping hand fans, charged flashlights, and supplies of candles ready in case of future similar disruptions.

Dispossession is not merely the physical detachment with material infrastructural support, but it also includes the loss of the social support that is important for people’s life. This can significantly affect the access and use of technologies in the life of people affected by residual mobilities. For example, while migrating to Dhaka one of our participants

left her mother in Rangpur, a district in Northern Bangladesh. Prior to a previous eviction, she maintained contact with her mother through her mobile phone, using a piece of paper with her contact numbers recorded and the help of a neighbor who knew how to use and dial the phone. Upon moving to Begunbari she lost both the paper and the neighbor, and subsequently most of the effective functionality of her phone, along with almost all her social contacts (including her mother).

Residual mobilities also often cause the dispossession of economic means, which in turn affects the use of technology in people's lives. Sudden experiences or increases in poverty often accompany eviction and migration, during which periods people may place higher priority on food, healthcare, or housing over technology. For example, when one of our participants was evicted from a previous location and migrated to Begunbari, she lost her job. Additionally she had to spend money to work out new shelter, food, and healthcare arrangements for her family. This left little money for electricity or mobile phone bills. As a result, she was detached from electrical technologies soon after her arrival in Begunbari.

#### *ii) Reconstitution and Resistance:*

The reconstitution of lost infrastructural support is an inseparable part of people's lives under conditions of residual mobility. Part of this may involve processes of reconnection to mainstream infrastructures. Other parts involve the restoration of social support, services, and contacts lost through displacement. Among its many other functions, social support is often crucial to technology use among poor and low-literate communities. After migrating to a new place, they need to redevelop social groups that will support their use of technology. Community gathering places like tea-stalls often help them rebuild this social support. A local tea-stall owner told us the following story of how new members of the community built connections and skills through conversations at his shop:

*“One day a newcomer came to my tea-stall and asked for a cup of tea. At that time Mr. J was discussing how he solved a problem regarding the FNF service on his mobile phone. The newcomer asked if Mr. J could help him activate that service on his mobile phone. Mr. J agreed, and eventually we all came to know each other.”* (FNF is a service allowing calls to some selected contacts cheaply)

Besides developing social support for using technology, a new person in a community also needs to know the people who provide, maintain, and repair infrastructural supports. For example, all our participants in Begunbari had to know and keep a good relationship with the electricians who maintain the local power lines and fix those. Similarly, they are familiar with the plumbers, cleaners, electric repairers, and shopkeepers in the community. Newcomers need to learn these networks, for reasons of both infrastructural and sometimes social support.

People undergoing displacement also often try to maintain or re-establish communication with contacts lost through migration or displacement. Most of our participants relied on mobile phones (their own or others) to maintain contact with relatives in rural areas and sometimes to transfer money through the services provided by the phone companies. Beyond these personal and familial connections, participants also relied on social networks for other kinds of support. For example, one of our participants maintains connections with a friend from a former neighborhood through mobile contact in part because of their dependence on the friend (who works at a pharmacy) as a source of medical advice and occasionally medicine. But economic and technical barriers often hinder this reconnection process. As a 35-year-old vegetable vendor in our study explained,

*“Although I miss my old friends in my village and in the places I lived before, I cannot afford calling them all. I only call people who have business with me. I saw on television that I could make cheap calls, but I do not know how.”*

#### *ii) Collaboration and Sharing:*

Like many other low-literate and low-income communities, Begunbari residents frequently borrow or share technical devices, and offer each other important technical assistance in basic digital literacy and operation. This matches forms of sharing and collaboration observed in other infrastructures. For example, during the period of our observations, residents were developing a new lane to connect main roads in two neighboring areas of South Begunbari. In other instances we observed neighbors collaborating to fix leaky pipes or broken sewer lines.

Again, people share their resources and help each other during the collapse of infrastructures. When water supply is broken, or when the sewerage pipes are clogged, the neighbors share their bathrooms, and toilets. Even when the gas lines break, they share their kitchen with their neighbors. However, the most common form of support is probably seen when power shuts down at nights. People were often seen to share their batteries, torchlights, and mobile phones to help each other. Also, it was very common for them to watch televisions, or listen to radios together when one's device is broken.

#### *iii) Hacking and Repairing*

As already reviewed above, life under conditions of residual mobility rests heavily on the ability to hack into mainstream infrastructure, and fix or restore broken technologies. Such actions become a key means by which infrastructural support is secured and maintained. Both hacking and repair activities involve many innovative and creative interventions that shape and reshape the technology to work under the conditions of residual mobility.

Illegal hacking activities are very common in Begunbari, and are indeed in many cases the only way to get access to

crucial infrastructures like water and electricity. One of our participants described his recent arrival in Begunbari as follows:

*“We came to Begunbari after being evicted from Mirpur slum. Although the house-owner told me there would be electricity, we did not find any. I had to call the local electrician who stretched an illegal line from the electricity wires that ran outside my window. We are still using that connection.”*

These hacking activities often meet resistance. Government officials periodically come to check the lines, sometimes cutting off connections and sometimes settling for bribes. Some of the hacks described above affect legal users who may also take action. As one such resident said,

*“We have always been using only one light and fan for our room. But 3 or 4 months ago, we noticed an abnormal leap in our electricity bill. We paid for that month. In the next month the bill raised further up. We sensed something wrong and then discovered the illegal connections that Begunbari people made to my lines. I immediately called the electrician and disconnected those.”*

Similar illegal hackings are prevalent in water, gas, sewerage and satellite cable connections. One family for example who could not afford satellite channel connections solved the problem by hacking into their neighbor’s satellite cable and stretching a second wire to their own television. Though the picture is not clear and often difficult to watch, they report being happy with the outcome.

Other kinds of creative technical responses can be found in repair. This includes the ubiquitous repair shops that service broken phones in and around the community, but also less formal repair knowledges, often passed around the community as tricks of the trade. We found one 40-year-old fish vendor drying his mobile phone in a bucket of rice, for example, who explained:

*“I sell fish in Karwan Bazar market. Often my mobile phone falls off my pocket into the basket of fish or into the bucket of water. Then it stops working. Then I put it in the container of rice for at least one day, and my phone starts working again. I learnt this from a friend of mine.”*

## DISCUSSION

Through the ethnographic data presented here, we have shown how the Government-led Hatirjheel waterfront project created forced mobilities in the lives of low-income residents and communities in the Begunbari area, and how those mobilities disrupted access to core infrastructures ranging from road and electricity networks to electronic and face-to-face forms of communication. We have also shown how residents pushed back, overcoming displacement and marginalization through informal hacks, fixes, and workarounds that restored or overcame (though never perfectly) the challenges and exclusions that displacement and residuality created. These findings have important

implications for HCI scholarship, in ways both immediate and extended.

We begin by noting the general absence of Begunbari (or places like it) in the general stories HCI tells about mobility, computing, and the relationships between them. Stories of dispossession – and especially radical forms of dispossession like those experienced by the residents of Begunbari – are largely (though not entirely [13,22,33]) absent from HCI’s general orientation to the world, which has tended to focus on moments of growth and development: the extension of core services and infrastructures, rather than their sudden and radical disruption. Asking what design can bring to such an environment poses interesting and provocative challenges. Services for timely reporting on eviction and support for short- and longer-term relocation efforts might help navigate uncertainties stemming from the sudden and multiple losses of infrastructure attached to dispossession. Real-time disaster mapping systems like *Crisismap* [38] might also be used to generate local and foreign support for the victims. Closer to home, individuals connected through social networks might leverage the benefit of extant systems to support some of the restorative or reconstitution functions described above. Our own separate research has suggested how mobile and crowd-supported systems in Bangladesh might provide support for services ranging from sexual harassment reporting [2] to distributed support for low-literacy users [3]. At the same time, research and design efforts may be extended to the infrastructure level to reduce users’ detachment from services. Proper maintenance and repair of such systems might require local expert communities to sustain such technologies [13]. Both government and private sources should explore the possibilities of temporary and modular service infrastructures to address short-term needs in the areas of housing, electricity, water, gas, and sewage disposal.<sup>1</sup>

Beyond such implications, our study has also underlined the distinctly collaborative forms of infrastructural use and engagement that help residents navigate and ameliorate the conditions of residual mobility. These findings match prior work that has shown how technology may be shared and used collaboratively among low-literate and low-income populations across a range of post-colonial and marginal computing contexts (as reported for example by Burrell [4], Medhi et al. [21], Ahmed et al. [3], Rangaswamy et al. [24], and Sambasivan et al. [26]). The conditions of residual mobility explored here both amplify and complicate these findings. On one hand, we see how shared-access and secondary use models (where people draw on technological benefits shared through friends and networks) become even more valuable as residents navigate the uncertainties of

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<sup>1</sup> One of the members of the project team is indeed working on a project to produce temporary, low-cost and modular housing solutions for victims of displacement.

displacement, and often lose place-based sites of gathering, information, and support (the neighborhood tea stand, relations with neighbors, etc.). On the other hand, access to technology itself may drop away, as local networks supplying access to technology or the knowledge needed to use it are dispersed. More detailed work on the relationship between infrastructural displacement and the reconfiguration of social interaction under conditions of residual mobility is an ongoing HCI need and interest.

In addition, from the uncertainty of displacement to community engagements in the hacking and fixing of infrastructure, our study raises important questions around HCI presumptions around certainty, fixity, and the (costless) longevity of systems and infrastructures. Classic HCI work by Suchman [31] has questioned the planning model at the heart of early artificial intelligence and HCI research, showing how the contingencies of place, context and situation can only ever be fully encountered and overcome in practice. This point comes through even more forcefully in worlds of residual mobility, where the presence of radical uncertainty makes ‘planning’ a somewhat quaint and foreign concept. If HCI is to arrive at more effective responses and interventions to the challenges confronting the residents of places like Begunbari, it may need a new set of metaphors that can live more comfortably with uncertainty – around resilience and recovery, for instance, or fixing and repair.

Our work also offers additional support to HCI themes of hacking, making, repair and other forms of creative material engagement as core and promising HCI ‘moments’ beyond those of design and use. Beyond their own inherent specificity and interest, post-colonial and marginal computing sites offer interesting and exemplary lessons here. Forms of innovation attached to the creative appropriation of infrastructure may open new windows of HCI work. Hacking cultures in China [18], and repair cultures in places like Bangladesh [13], Namibia [14,15], and Uganda [11] have already demonstrated distinctive and creative engagements with technologies that depart from Western norms and assumptions. The forms of infrastructural hacking and fixing woven into the everyday life and survival of people in places like Begunbari can further advance this program of work.

Finally, while our case has built from the immediate circumstances of Begunbari and the broader field of post-colonial computing, we wish to emphasize that residual mobilities and the forms of infrastructural displacement identified here are neither isolated incidents nor limited to postcolonial contexts (though they may appear in such contexts in particularly raw or ‘pure’ form). Millions of people around the world encounter some version of infrastructural displacement or residual mobility on an ongoing basis, whether driven by war, natural disaster, or extreme poverty attached to economic stagnation or collapse. Residual mobilities are also present in ‘northern’

contexts – arguably all the more so as traditional social safety nets are stripped away and the “modern infrastructural ideal” [7] splinters and decays. Here we note important parallels to HCI work addressing conditions and experiences of residual mobility and technology engagement in other seemingly very different contexts: for example, Jill Woelfer’s [36] or Chris Le Dantec’s [5] work on technology use and appropriation among homeless populations in Washington DC and Atlanta; or Julia Elyachar’s [6] work on the forms of phatic labor that ensure ongoing social support, access and connection in Cairo. Under these conditions, understandings of residuality – and the challenges, deprivations, but also creative possibilities it encodes – become more central to HCI work and experience as a whole. Better attention to the varied forms of mobility and marginalization but also creative engagement with infrastructure occurring in places like Begunbari may further extend these lines of analysis, drawing new possibilities of comparative learning and analysis. It is also important if we are to avoid the limits of an HCI ‘overfitted’ to the conditions of Western social, economic and infrastructural assumptions.

## CONCLUSION

This paper contributes to HCI by expanding the range and experience of mobilities the field has typically considered. We have introduced the concept of residual mobilities to better account for the technology experiences and infrastructural engagements characterizing people undergoing radical experiences of displacement. We have also pointed to the innovative and creative practices of infrastructural hacking and fixing as overlooked but potentially novel sites of HCI insight and innovation. Better accounting for such sites and experiences may help overcome the traditional limits and biases embedded in the assumptions of our field. It may also help the HCI research community develop new forms of listening and engagement in an increasingly complex and global world.

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