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CONCEPT

Exploring Factors Influencing the Users' Intention to Use *Aarogya Setu* Contact Tracing Mobile Health Application during COVID-19 Pandemic

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ABSTRACT

The purpose of the study is to explore the cognitive and social factors influencing the usage intention of *Aarogya Setu* m-health app. This paper draws on extended technology acceptance model (TAM 2) to develop a conceptual framework to explain the factors influencing the usage intention of the *Aarogya Setu* m-health app.

The study suggests a framework which explains the factors such as "Perceived ease of use", "Perceived usefulness" and "Perceived privacy risk" determines the usage intention of the *Aarogya Setu* m-health app, where as "Subjective norm" has no impact on usage intention. Four research propositions are postulated to promote the future research.

Keywords: *Aarogya Setu*, TAM, Intention to use, Contact tracing, m-health app.

Introduction

Contact tracing, followed by isolation and early treatment are crucial control measures to combat infectious diseases (Eames and Keeling 2003). The current pandemic caused by novel coronavirus, is a highly infectious respiratory disease and according to WHO, the virus spreads over 215 countries around the globe and is responsible for high casualty. As there are no specific therapeutic drugs and vaccines available to neutralize or control the virus, social distancing and contact tracing are two effective measures to check the spreading of the virus to certain extent. Contact tracing mobile health applications (m-health app) are climacteric measures for the COVID-19 surveillance, risk assessment, contact tracing of infectious persons and situation evaluation (Kodali et al. 2020). As manual contact tracing procedure is inefficient and time taking process, leads to poor control over infection status monitoring, most of the countries have adopted ICT enabled tracking facilities as a public health care strategy for fast tracking and easy to manage the infection spreading and mobile based application (app) helps users to aware about their own health status

with respect to infectious person and suspected persons around them (Vaithianathan et al. 2020).

Indian's m-health app, *Aarogya Setu* which is designed for contact tracing of infectious person and provides health tips to get rid from novel coronavirus has significantly contributed in terms of contact tracing and disease management during COVID-19 pandemic (Kodali et al. 2020). After launching by Government of India (GoI) on 2nd April 2020, the app is the most downloaded and reviewed among all heath and contact tracing applications available in google play store (Davalbhakta 2020). *Aarogya Setu* contact tracing m- health app is based on Bluetooth enabled contact tracing technology, which collect information from nearby devices and update the infection status as well as number of users under different predefined ranges and their self-assessment status.

To use m-health application depends upon the different cognitive and social factors of the users (Cho et al. 2014). *Aarogya Setu* m-health app is a new and important mobile app, used during this pandemic for personal and public health safety. It is important for the policy makers

and researchers to understand the factors, which are influencing the intention to use of *Aarogya Setu* m-health app, which can help them to make action plan for the large scale adoption of this m-health app to check the spreading of novel coronavirus. In this study, we developed a conceptual framework to explain the factors that influence the intention to use *Aarogya Setu* m-health app. The factors are extracted from previous study and organized in the conceptual framework by relying on TAM 2 model (Venkatesh and Davis 2000).

Contact tracing and mobile health application

Contact tracing is an important and essential tool for the Government to check the spreading of novel coronavirus (Cho et al. 2020). It is a mechanism of detecting potentially infected people by analyzing the patient's social contacts. This can be done through a mobile app with Bluetooth as the technology and that Bluetooth used to determined direct face to face interaction by collecting the Bluetooth IDs of each person come closer and the Governments in some countries are using GPS based contact tracing mobile app to track the infected people (Brack et al. 2020). The contact tracing m-health apps are now gaining importance by different countries for example, the Singapore Government has developed a contact tracing m-health app called, "Trace Together" (Abeler et al. 2020), China and Israel have also developed their GPS enabled contact tracing mobile app to get the contact details and infection status of the infected persons (Jhunjhunwala 2020).

The Indian version of contact tracing m-health app, "*Aarogya Setu*" is designed for android operating system, iOS operating system and featured phones and can be operated by the users with any network types like 2G, 3G and 4G and the app is available in 11 different Indian languages. A person can download the app and first carry out self-assessment, which helps users to know about the risk of being infected by answering a few questions related to their health condition, symptoms and travel history over the last fifteen days (Jhunjhunwala 2020). *Aarogya Setu* m-health app uses low-intrusive Bluetooth signals between individuals and the infected person to determine the proximity. All the information captured during self-assessment is uploaded in the secure server of "National Informatics Center" (NIC) along with the user's geo-location via GPS with a proper user consent. Later the application only uses GPS to detect the coronavirus infection density in a particular geographical region and never trace user's movement via GPS according to privacy policy of the app (Jhunjhunwala 2020).

Theoretical background

In this study, we adopted extended TAM, also known as TAM 2 established by Venkatesh and Davis (2000), to explain the intention to use Arogya Setu m-health app. Because TAM 2 is believed to be the most robust and appropriate to explain the behavioral intention and actual behavior to access Information system and in this theoretical model all the independent constructs are strongly explained the variance in usage intention (Venkatesh and Davis 2000). TAM 2 is the theoretical extension of Technology Acceptance Model (TAM; Davis 1985) which inspects the behavioral intention and actual behavior of an individual towards a technology by excluding the mediating factor "Attitude" of original TAM. Figure 1 illustrating the three antecedents to "behavioral intention for a technology' ultimately which leads to actual usage behavior of the technology. We excluded other factors of TAM 2 which do not directly influence the intention to use a technology.

Conceptual framework and propositions

We draw on TAM 2 to organize our framework and in the present model, intention to use is examined rather than actual behavior towards *Aarogya Setu* m-health app because this m-health app is new for the users and still at initial stage. We incorporated an additional factor in our conceptual framework namely "Perceived Privacy Risk" (PPR), which is an important factor influence the intention to use *Aarogya Setu* m-health application because mobile apps which access the personal information of the users, their usage always influenced by PPR (Merhi et al. 2019). Figure 2 provides a graphical representation of our
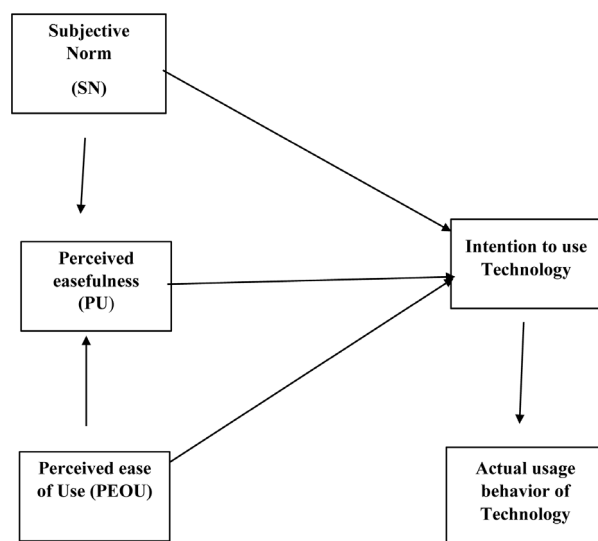

Figure 1: Extended Technology Acceptance Model (TAM 2; Venkatesh and Davis, 2000)
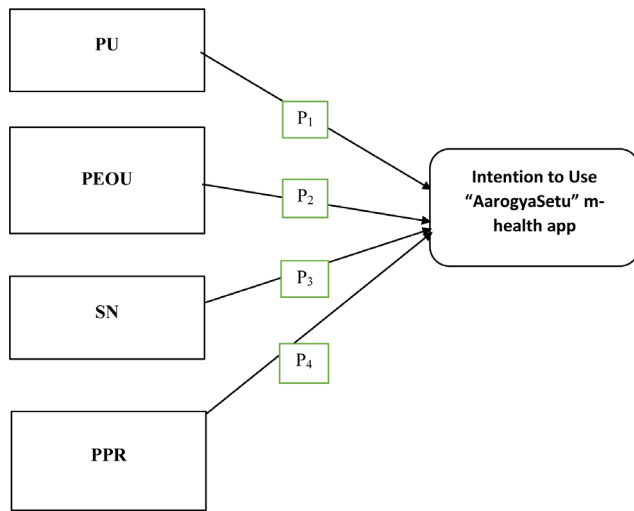
Figure 2: Antecedents of intention to use *Aarogya Setu* m-health app.

conceptual framework, in which "Perceived usefulness" (PU), "Perceived ease of use" (PEOU), "Perceived Privacy Risk" (PPR) and "Subjective Norm" (SN) are antecedents of intention to use the Arogya Setu m-health app.

Antecedents of intention to use *Aarogya Setu* m-health app

According to TAM 2, PU and PEOU are two important independent constructs which directly influence the intention to use a particular technology. In this study, we adopted PU and PEOU of *Aarogya Setu* m-health app as antecedents of intention to use *Aarogya Setu* m-health app. Another important factor which is incorporated in TAM 2 is SN, derived from Theory of Reasoned Action (TRA; Fishbein and Ajzen 1975). We considered SN as an antecedent of intention to use the *Aarogya Setu* m-health app. PPR is considered as an important factor and antecedent for using mobile app (Wang et.al 2016;

Merhi et al. 2019) hence in our study, we incorporated the PPR in the conceptual framework as an antecedent of intention to use *Aarogya Setu* m-health app.

Perceived Usefulness (PU)

PU refers to, "the degree which a person believes that using a particular system or technology enhances his or her ability to perform a job or task" (Davis 1989). PU has a positive and direct impact on usage intention of information technology (Taylor and Todd 1995; Venkatesh and Davis 2000). A study by Lu et al. (2003) conceptualized that PU positively and significantly influences the usage intention of wireless internet through portable devices (e.g. mobile, tabs and laptops). Some empirical evidence from various studies confirmed the effect of PU on usage intention of m-health app. PU has a strong and significant impact on usage intention of m-health apps (Mohamed et al. 2011). A study on Singaporean women by Lim et al. (2011) found that the intention to use mobile phones to seek health information was positively and significantly predicted by PU. The usage intention of health care mobile devices like mobile phones, tablets etc. among the health care professionals significantly and positively influenced by the PU of the devices (Rasmi et al. 2018). The PU has a strong impact on intention to use m-health apps by senior citizens in Iraq (Saree et al. 2019). The investigation of PU and its impact on usage intention, both for m-health care devices and in m-health app usage behavior context confirmed that PU is a good predictor of usage intention of m-health app. Therefore, we proposed the following proposition:

P1. **Perceived usefulness of *Aarogya Setu* m-health app will have a significant impact on intention to use *Aarogya Setu* m-health app.**

Table 1: Operational definition of factors identified as antecedents of intention to use *Aarogya Setu* mobile application.

Constructs /Factors	Operational Definition	Source
PEOU	PEOU refers to, "the degree to which a person believes in the use of technology or information system requires less effort".	Venkatesh and Davis (2000); Davis et al. (1989)
PU	PU can be defined as, "the degree to which a person thinks a given technology or information system could improve his/her performance".	Venkatesh and Davis (2000); Davis et al. (1989)
PPR	Privacy risk can be defined as, "Profess of individuals, to determine for themselves when, how and to what extent information about us is communicated to others".	Merhi et al. (2019); Miyazaki and Fernandez (2001); Westin (2003)
SN	SN refers to "the social pressure by peers (e.g. friends, family members) which motivate an individual to perform a behaviour.	Ajzen (1991); Fishbein and Ajzen (1975); Venkatesh and Davis (2000)
Intention to use or Usage intention	It can be defined as the conscious plans of an individual or the likelihood that the individual will perform a certain behaviour or not	Ajzen (1991); Fishbein and Ajzen (1975); Venkatesh and Davis (2000)

Perceived ease of Use (PEOU)

PEOU refers to, "the degree an individual believes that using a technology would be free of effort and effort can be the resource which a person allocates to different tasks for which he or she is liable (Davis 1989). The research on theoretical extension of TAM, which was a longitudinal study by Venkatesh and Davis (2000), confirmed that PEOU has a direct and positive impact on usage intention. A focus group study, carried out by Schnall et al. (2015) among the persons living with HIV and HIV health care providers those are using m-health app for monitoring and management of HIV, found that PEOU is a major predictor of intention to use m-health app to monitor and manage the HIV. A study based on TAM 2 confirmed that PEOU has a significant impact on usage intention of m-health care systems among the medical professionals (Wu et al. 2007). Intention to use health care informatics via m-health app, designed for health care advice for women well-being, among the ageing women determined by the PEOU of the health care informatics (Xue et al. 2012). Findings of a meta-analysis conducted by Zhao et al. (2018), included 35 previous studies on mobile health service adoption to analyze the 8 factor's influences towards attitude and behavior, reviled that PEOU as a major determinant for usage intention of m-health care services. The investigation refers, the PEOU is an important antecedent for usage intention of m-health app, therefore we postulate the following proposition:

P2. **Perceived ease of using** *Aarogya Setu* **m-health app will have a significant impact on intention to use** *Aarogya Setu* **m-health app.**

Subjective Norm (SN)

SN, considered as a major predictor of behavioral intention in the Theory of Reasoned Action (TRA; Fishbein and Ajzen 1975), and later it was included in the Theory of planned behavior (TPB; Ajzen 1991). SN refers, "the function of normative belief about the social expectation of significant of others (e.g., friends, spouses, parents etc.), in other way it can be defined as the social pressure, an individual faces while deciding whether to behave in certain way" (Park 2000; Venkatesh and Davis 2000). The reason behind the direct effect of SN on behavioral intention is individuals may select to perform a behavior, even they are not motivated to perform a behavior, if they believe their peers think they should, and then they may be motivated to perform the behavior by complying with them (Venkatesh and Davis 2000). Davis et al.

(1989), in their study found that SN was not a determinant for behavioral intention to accept computer technology and mention for further research to investigate the impact of SN on usage behavior. In TAM 2 it is empirically concluded that SN has a positive and significant impact on usage behavior (Venkatesh and Davis 2000). Many prior empirical researches have been done in the context of the m-health app to understand the impact of SN on intention to use m-health app. A study in India by Pai and Alathur (2019), found no significant impact of SN on intention to use m-health apps. Subjective norm has a very less significant impact on usage intention of m-health app among the older adults (Saare et al. 2019). The findings of a comparative study between middle aged and old users by Deng et al. (2014), confirmed that SN has no significant impact on usage intention of m-health app for two groups. SN has an indirect effect on acceptance of IT health services and is mediated by PEOU (Yu et al. 2009). The above investigation on prior research on adoption of m-health apps confirmed that SN has no significant impact on usage intention of m-health apps and in some cases, SN has indirect effect on usage intention of m-health apps. By noting this findings, we proposed the following proposition:

P3. **Subjective norm will have no direct and significant impact on intention to use the** *Aarogya Setu* **m-health app.**

Perceived Privacy Risk (PPR)

Privacy and security in e-services or internet enabled services context is of considerable importance to users and regulators (Featherman et al. 2010). Users always evaluate various types of risk, while deciding to use e-services (Featherman and Pavlou 2003). Data privacy is one of the important perceived risks while users choose to adopt e-services (Miyazaki and Fernandez 2001). According to Westin (2003), information privacy can be defined as, "Claim of individuals, to determine for themselves when, how and to what extent information about us is communicated to others". Individuals always reckon risk and benefit while deciding whether to disclose the confidential information, if risk outweighs the benefits then they don't want to disclose such information (Culnan and Armstrong 1999). In prior studies, it was empirically concluded that, PPR has a negative impact on usage intention of e-services (Sheehan and Hoy 1999; De Ruyter et al. 2001; Featherman et al. 2010). In e-health services context, m-health monitoring and management app largely determined by the privacy concern of personal health information (Premarathne et al. 2015). Various m-health

apps collect and offer critical sensitive health information, if the privacy is not maintained properly then it leads to poor adoption of m- health apps (Delhing et al. 2015). Privacy and Security features assist users to select m-health app (Adhikari et al. 2014). Privacy concern has a negative and significant impact on intention to adopt m-health care services (Guo et al. 2012). Data privacy is an important factor to adopt the contact tracing cum m-health app during pandemic and people are more concern about their private data while choosing contact tracing m-health app (Rowe 2020; Altuwaiyan 2018; Bengio et al. 2020). By investigating the prior research, we postulate the proposition:

P4. Perceived privacy risk for *Aarogya Setu* m-health app will have a negative and significant impact on intention to use the *Aarogya Setu* m-health app.

Discussion

The current pandemic due to the novel Coronavirus is putting pressure on public health administrators and policy makers to keep the public protected from the virus and control the spreading of disease through different strategies like contact tracing, social distancing and create awareness for prevention measures among the people. The contact tracing m-health apps are useful to trace the contact details of the infected person and provide different health and prevention measure tips which help people to combat the virus. Users' intention to use these mobile apps need to be understood, so that a better strategy can be formulated to increase the adoption of the contact tracing m-health app. In our study, we try to understand the factors which are influencing the usage intention of *Aarogya Setu* m-health app by conceptually reviewing the prior studies and developed a framework, which illustrate the four antecedents of intention to use *Aarogya Setu* m-health app. We rely on TAM 2 to develop our own version of TAM for *Aarogya Setu* m-health application.

The two main predictors namely PU and PEOU of TAM 2 incorporated in our framework to understand the usage intention of *Aarogya Setu* m-health app. By investigating prior studies in the context of m-health app, we concluded that usage intention of *Aarogya Setu* m-health app can be determined by PU of *Aarogya Setu* m-health app and PEOU of this mobile app. Many empirical studies found that usage intention of m-health apps significantly predicted by these two factors (Wu et al. 2006; Mohamed et al. 2011; Xue et al. 2012). We conceptualized PU of the *Aarogya Setu* m-health app by relying on

the original definition of Davis (1989) as, "the degree an individual thinks by using *Aarogya Setu* m-health app help him/her to know about the infection status of a particular area and help him/her for self-assessment during pandemic". The PEOU of *Aarogya Setu* m-health application can be defined by relying on the definition of Davis (1989) as, "the degree an individual thinks that less effort is required to use the *Aarogya Setu* m-health app".

PPR is another predictor of *Aarogya Setu* m-health app. In our investigation on impact of PPR on usage intention of m-health app, many empirical evidences from prior studies (Culnan and Armstrong 1999; Delhing et al. 2015; Rowe 2020) confirmed that PPR has a negative and significant impact on intention to use m-health app. By relying on the definition of information privacy by Westin (2003), we conceptualized the definition of PPR for *Aarogya Setu* m-health app as, "Claim of *Aarogya Setu* m-health users, how, when and what extend their personal health information shared with other users". Another construct, SN which positively and significantly influence the intention to use in TAM 2 (Venkatesh and Davis 2000) has no impact on usage intention of m-health app (Deng et al. 2014;Pai and Alathur 2019) hence, we concluded that social pressure is not a predictor for intention to use *Aarogya Setu* mobile application.

Theoretical and managerial implications

Discussing about theoretical implications, this study developed a TAM framework for *Aarogya Setu* m-health app, which helps to understand the intention to use *Aarogya Setu* app during pandemic. We proposed four propositions, which confirmed how the four factors influence the intention to use *Aarogya Setu* m-health app and conceptually defined each factor for *Aarogya Setu* m-health app context. This study will provide a theoretical understanding for Contact tracing and m-health apps for future studies.

The conceptual framework and the conceptually defined each factor for the *Aarogya Setu* m-health app help the health policy makers and administrators to get a better insight for an individual's intention to use the *Aarogya Setu* m-health app. The policy makers should focus to create awareness for the usefulness of the Arogya Setu m-health app. Features and accessibility of the *Aarogya Setu* m-health app can be improved for hassle free and less effort to use the mobile application. The personal health information, those are stored in the NIC database and shared with users need to be protected and privacy of health information should be maintained safely and

securely without any data breach to increase the usage of *Aarogya Setu* m-health app.

Conclusion

This study refers to the TAM framework for intention to use *Aarogya Setu* m-health app by relying on TAM 2 for theoretical underpinning. We concluded that the factors such as PU, PEOU and PPR are the determinants of usage intention of *Aarogya Setu* m-health app, where as the SN has no direct impact on intention to use *Aarogya Setu* m-health app, which contradicts the theory. PEOU and PU positively influence the intention to use *Aarogya Setu* m-health app and PPR has a negative impact on intention use, which refers, if the PPR weighted than the benefit of *Aarogya Setu* m-health app then it will decrease the use of the app. At the end we conceptually defined the factors in our study context which influence the intention to use the *Aarogya Setu* m-health app. This study may help researchers to carry forward further research on intention to use contact tracing m-health app. Our developed framework and conceptually defined factors in the context of *Aarogya Setu* m-health app, can help the policy makers and health administrators to understand behavioral intention for *Aarogya Setu* m-health app in a better way and can help policy makers and administrators to improve the accessibility of the app.

Limitations and future research

Some limitations are noted in our study, this study solely depends on the previous study, without including any empirical data. We only established the relationship between the independent constructs (e.g.PU, PEOU, SN, PPR) and dependent construct(Usage intention), rather examining the relationship between the independent constructs, which are related according to TAM 2. We only included four factors to examine the relationship with intention to use, whereas other factors may influence the intention to use mobile health applications.

The future research may empirically test the proposition, by gathering data from the users for better validation of the study. Multivariate techniques like structural equation modeling can be used for construct validation and reliability and can predict the structural pattern between the latent constructs of this study. The framework may be useful to understand the intention to use contact tracing and m-health apps in different settings. Impact of SN on usage intention of m-health app needs to be studied further for a better understanding.

Competing Interest Statement

All authors have read and approved the manuscript and take full responsibility for its contents. No potential conflict of interest was reported by the author(s).

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