

DISSERTATION
REPORT
PRESENTATION

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**STUDY ON TAM (TECHNOLOGY ACCEPTANCE MODEL) OF
BLE (BLUETOOTH LOW ENERGY) BASED BEACON
TECHNOLOGY FOR THE HOSPITAL OPERATIONS AT GCS
HOSPITAL, AHMEDABAD.**

INTRODUCTION

- COVID-19 pandemic has become a hefty Healthcare confrontation among the world. The current critical situation has forced the Hospitals to maximize the use of Digitalization of Healthcare services. The post COVID-19 situations will bystander an increased expends on Digitalization of Healthcare services by Health-care System to ensure patient safety. There are several healthcare solutions which can be used to develop a contactless work flow of Hospital operation which will further support the contact tracing of COVID-19 infection. Hence, RFID and BLE based Beacon technology provides an opportune Digital solution for the Hospitals as per the demanding situation.
- In RFID Technology, RFID consists of small tags which include small or miniature sized circuitry that are detectable by radio waves. The size of RFID tags varies as per the requirement it can be similar to the size of Key chain or as thin as paper labels. The number of data string which can be stored and the distance from which it can be read depends upon the size of the tag. RFID can be mainly divided into two types such as active and passive tags. The read distance depends upon the type of RFID tag whereas RFID tag does not require “line of sight” for reading the data.
- The passive RFID tags does not include any battery whereas they capture power from the radio waves emitted by the reader and mirror them back to the reader. As soon as the reflected wave is grabbed by the reader, the tag along with its parameters is identified by the reader. The major drawback of passive RFID tags is that they are unable to provide real-time location and complex to set up. Hence, the reading range is typically less than twenty feet.

- Active RFID tags incorporate a battery which results in an increased read range of RFID tags up to hundred feet. The high read range of active RFID overcomes the drawback of passive RFID tags. In Hospitals, RFID found its application when it came to monitoring of Hospital assets. There are several drawbacks of passive RFID tags such as inability to provide real time location due to power consumption, prohibitive cost and complexity in setting up. On the contrary, RFID tags are less preferred when the tracking needs to be done using a mobile phone.
- BLE based Beacons are a small sized radio transmitter that sends BLE signals to the nearby Bluetooth/mobile device and works on wireless technology. BLE based Beacons are majorly constructed for short range communications. It connects with a mobile application installed on the Bluetooth/mobile device and generates specific actions as per the requirement. Hence, BLE based Beacon devices are miniature in size and can be mounted across various locations, to broadcast low energy Bluetooth signals in a given specified range. BLE based Beacon mainly works on two Beacon protocols such as Eddystone and iBeacon. Eddystone is a Google based protocol released in 2015. It is an open format designed for complete freedom and transparency to develop creative projects whereas iBeacon is an Apple based protocol that broadcasts their identifier to nearby portable electronic devices. The identifier and the several bytes sent, can be used in various real time applications like determining device's physical location, track customers, push notifications and many more. There are several types of BLE based Beacon such as small beacon, standard beacon, parent beacon, USB beacon and special beacon. Hence, in Hospital Beacons can be used for Patient tracking, Asset tracking, Easy navigation, Optimized Operations, Analytics, Analytics, Digital Access Control and Digital marketing.

- In patient tracking, the patient vital signs can be tracked by integrating the beacon devices with wearable such as wristbands or accessories which forms a two-way communication and also captures location data to the level of a Hospital bed. In Asset Tracking, the chances of misplaced assets are minimized which further result in reduced purchase of repeat asset. As a result, considering the active nature of Healthcare operations, there is a risk of Hospital theft and a possibility for Hospital assets or equipment to be inaccessible when really required. In case of easy navigation, the BLE based Beacon application provides the real time status of Doctor Appointments to patients while waiting at a Healthcare center and navigate them through a right path to the assigned Doctors chamber. The beacon also helps the patients to guide them to in house Hospital departments as per their need and requirement. Beacons also provide Digital Access Control by initiating Bluetooth tags at each access point which enable record or identity management & requisite availability of data. Hence, Beacons works as a catalyst in Healthcare and Hospital operations in various ways such as by using beacon technology, the Nursing staff gets the information related to type of medication the patient has been prescribed. The Emergency notifications are sent out easily to gain fastest possible attention from nearby medical staff. The Doctor can also use beacon technology to refer information related to patient's course of treatment. The Hospital staff gets notifications as per their assigned duties and other emergency duties on their cell phones when they reach their workplace or work area.
- This study investigates the acceptance level of GCS Hospital staff in infusing BLE based Beacon technology in their Hospital. In order to achieve this, Technology TAM is used as a theoretical basis for predicting Hospital staff acceptance of this BLE based Beacon technology. The research discussed in this paper was guided by the following question: If BLE based Beacon technology was to be introduced at GCS Hospital; will Hospital staff accept and subsequently use it? That is, do Hospital staff attitudinal beliefs such as perceived ease of use and perceived usefulness of BLE based Beacon technology predict its adoption? This question is explored with the use of TAM. Hence the main purpose of this study was to use TAM to assess the possibility of acceptance of BLE based Beacon technology by GCS Hospital staff, and provide a well-supported prediction of whether it will be utilized in the Hospital environment at GCS Hospital

OBJECTIVE

To study the usage and acceptance of BLE based Beacon Technology by Hospital Staff

MATERIALS AND METHODS

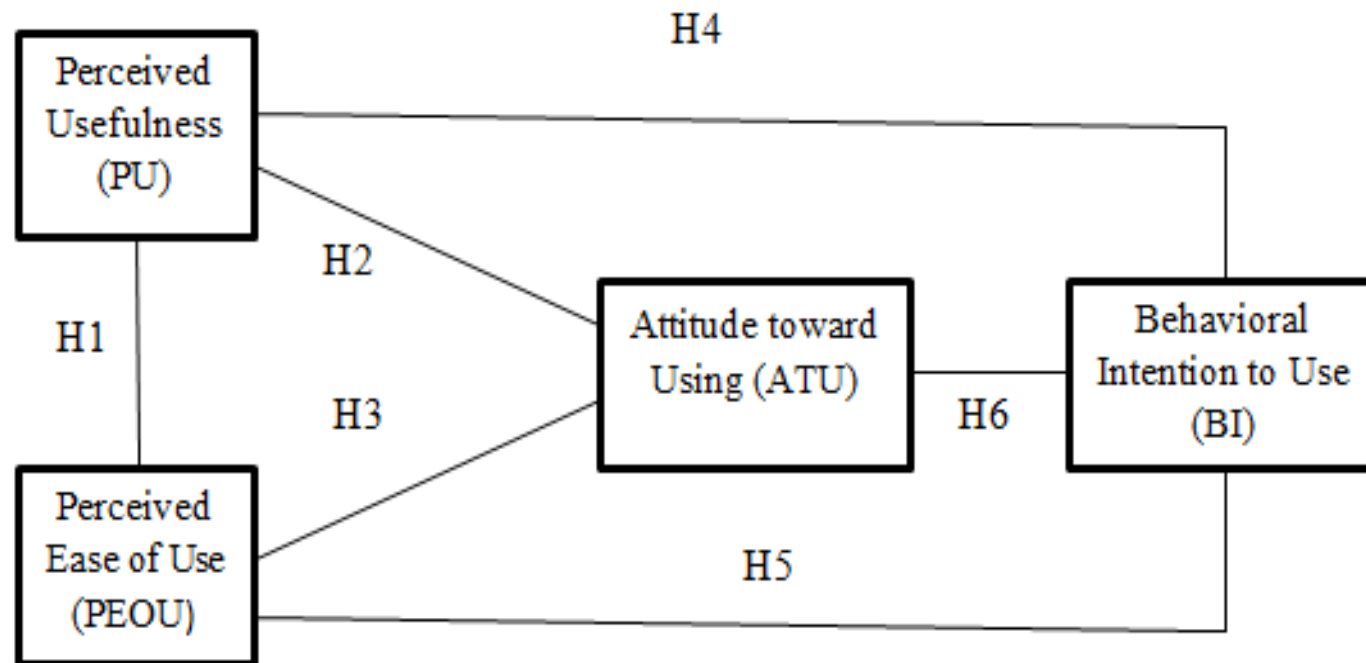
TECHNOLOGY ACCEPTANCE MODEL (TAM)

'TAM model' is known for checking possible acceptance of technology. Fred Davis and Richard Bagozzi created it first. It shows the reason behind peoples thinking to choose a technology. "TAM states that to do so because they find the technology useful for their work and easy to use."

'TAM' concepts are:

- PU – "the degree to which a potential user believes that using the technology would enhance his or her work performance".
- PEOU – "how effortless a potential user believes using the technology will be".
- ATU – "a potential user's positive or negative feeling associated with performing a specific behavior", and
- BI – "the degree to which a potential user has formulated conscious plans to perform or not perform some specified future behavior".

RESEARCH MODEL



There are several existing literature shows that PEOU is a positive determinant of PU, therefore the following hypothesis is proposed:

H1: There is a significant relationship between PEOU and PU.

Many studies also show that both PU and PEOU are significant determinants of attitude to use a system, so the researchers propose the following hypotheses:

H2: There is a significant relationship between PU and Hospital Staff attitudes towards using BLE based Beacon Technology

H3: There is a significant relationship between PEOU and Hospital Staff attitudes towards using BLE based Beacon Technology

PU is the most important predictor of intention to use a system. PEOU has also influenced intention to use a technology. Therefore, the following hypotheses are proposed:

H4: There is a significant relationship between PU and Hospital Staff intention to use BLE based Beacon Technology.

H5: There is a significant relationship between PEOU and Hospital Staff intention to use BLE based Beacon Technology.

Several other studies have demonstrated that attitude towards using a system is a direct determinant of behavioral intention to use technology. Therefore, the following hypothesis is proposed:

H6: There is a significant relationship between ATU and Hospital Staff intention to use BLE based Beacon Technology

METHODOLOGY

- Sampling Technique – Probability sampling (Simple Random sampling)
- Sample size formula -

$$\text{Unlimited population: } n = \frac{z^2 \times \hat{p}(1-\hat{p})}{\epsilon^2}$$

$$\text{Finite population: } n' = \frac{n}{1 + \frac{z^2 \times \hat{p}(1-\hat{p})}{\epsilon^2 N}}$$

where

z is the z score

ε is the margin of error

N is population size

p̂ is the population proportion

- This is a cross-sectional, descriptive and correlational study based upon TAM of BLE based Beacon technology on 100 Hospital staff from GCS Hospital, Ahmedabad.

- A paper-based as well as an online semi-structured questionnaire was developed by using Google forms, with a consent form affixed to it which was used to collect data from the study's test subjects, who were Hospital staff. The questionnaire was developed on the basis of the literature review.
- The link of the questionnaire as well as the Hard copy of questionnaire was sent through e-mails and Whats App among the Hospital staff of GCS Hospital. On receiving and clicking the link the participants got auto directed to the information about the study and informed consent. Then a set of several questions appeared sequentially, which the participants were to answer. It was an online/offline study. Participants with age more than 18 years, able to understand English and willing to give informed consent were included.
- The socio-demographic variables included age, gender and education. The online self-reported questionnaire developed by the investigators contained the sections related to the TAM constructs of PEOU, PU, ATU and BI, adapted in the context of BLE based Beacon technology. Questions in sections B were structured using a seven-point Likert-type scale designed as follows: 1 = Extremely Agree, 2 = Quite Agree, 3 = Slightly Agree, 4 = Neutral, 5 = Slightly Disagree, 6 = Quite Disagree and 7 = Extremely Disagree. The participants were asked to rate their level of agreement to closed questions using this scale. A simple random sampling without replacement was used to select the 100 participants in this study.
- For data analysis, a MS-Excel spreadsheet was used for database elaboration, and afterwards the SPSS software version 22.0, for descriptive and inferential statistical analysis of data was also used. Parameters of mean and standard deviation were utilized for descriptive analysis, Pearson Correlation Test between PEOU, PU, ATU and BI with test's descriptive level for $p < 0.05$.

RESULTS

DEMOGRAPHIC CHARACTERISTICS

- By considering the participants' demographic details as shown in Table 4.1, responses were received from 66 males and 34 females, giving 66 % and 34 % respectively. All the participants were above 18 years of age and GCS Hospital staff. The study included only those participants who understood English. An online survey, related to TAM for BLE based beacon technology was conducted in GCS Hospital, Ahmedabad. A total of 100 responses were recorded. Hence, by default individuals with a higher level of education was included in the study. The lowest educational level in this study was observed to be standard 12th. The highest qualification of more than 80 % of the population was graduation and above.

PEARSON CORRELATION ANALYSIS

The Pearson Correlation analysis provides the strength of relationship among the given variables.

A significant relationship was found between PEOU and PU, and this reinforces the hypothesis H1 (significant level = 0.415).

H1: There is a significant relationship between PEOU and PU.

The results also indicate that there is statistically sufficient evidence regarding the impact of PU on the attitude of Hospital staff to use BLE based Beacon technology. This is shown by reinforcement for H2 (correlation coefficient = 0.272).

H2: There is a significant relationship between PU and Hospital staff attitudes towards using BLE based beacon technology.

The results also reinforce for a significant relationship between PEOU and Hospital staff attitude towards using BLE based Beacon technology. This means the results reinforce hypothesis H3 (correlation coefficient = 0.377).

H3: There is a significant relationship between PEOU and Hospital staff attitudes towards using BLE based Beacon technology

Hypothesis H4 is also reinforced by the results as they show a statistically significant relationship between PU and Hospital staff intention to use BLE based Beacon technology. This is at a 0.181 correlation coefficient.

H4: There is a significant relationship between PU and Hospital staff intention to use BLE based Beacon technology.

The data also indicate reinforce for hypothesis H5. The results show a significant positive relationship between PEOU and Hospital staff intention to use BLE based Beacon technology. Hence, this is at a 0.439 correlation coefficient.

H5: There is a significant relationship between PEOU and Hospital staff intention to use BLE based Beacon technology.

At last, there is statistical proof to reinforce hypothesis H6. The results show a significant relationship between Hospital staff attitude to use BLE based Beacon technology, and their intentions to use BLE based Beacon technology. This reinforce of hypothesis H6 is shown by a 0.170 correlation coefficient.

H6: There is significant relationship between ATU and Hospital staff intention to use BLE based Beacon technology.

Item	Response percentage						
	Extremely Agree	Quite Agree	Slightly Agree	Neither	Slightly Disagree	Quite Disagree	Extremely Disagree
PEOU 1	20	25	30	24	1	0	0
PEOU 2	26	34	16	20	3	1	0
PEOU 3	30	28	15	27	0	0	0
PEOU 4	28	28	23	19	2	0	0
PEOU 5	10	34	17	38	1	0	0
PEOU 6	30	25	15	28	2	0	0

Item	Response percentage						
	Extremely Agree	Quite Agree	Slightly Agree	Neither	Slightly Disagree	Quite Disagree	Extremely Disagree
ATUB 1	37	35	10	16	2	0	0
ATUB 2	36	37	9	14	2	2	0
BI 1	29	41	20	9	1	0	0
BI 2	35	24	26	14	1	0	0
BI 3	34	40	16	9	1	0	0

Item	Response percentage						
	Extremely Agree	Quite Agree	Slightly Agree	Neither	Slightly Disagree	Quite Disagree	Extremely Disagree
PU 1	30	36	19	15	0	0	0
PU 2	32	29	20	19	0	0	0
PU 3	27	36	16	17	2	2	0
PU 4	36	29	14	19	6	0	0
PU 5	30	35	21	14	0	0	0
PU 6	28	39	16	16	1	0	0

PEOU, PU, ATU AND BI OF (BLUETOOTH LOW ENERGY)BLE BASED TECHNOLOGY

CONCLUSION

- This study proves that PEOU and PU are significantly related with attitude of people towards using a BLE based beacon technology. So PEOU is direct determinant of PU. BLE based beacon technology is useful when we talk about opinion of hospital staff, although formed plans are there. With respect to this study the Behavior of staff also shows their intentions to use the BLE based Beacon technology. This is also in agreement with TAM that meets with the criteria even with other literature too, which “influence behavioral intention to use that technology”.
- This study also proves that PEOU is not a direct determinant of BI whereas “PEOU is a critical driver of BI”. If the Hospital staff found BLE based Beacon technology to be easy to handle, along with other benefits then they will form positive behaviors of integrating it into Hospital environment at GCS Hospital, Ahmedabad. Studies show that “demographic characteristics such as age, gender and educational qualifications can influence a person’s acceptance of a new technology”, which will help to investigate if Hospital staff demographic factors do indeed influence their “acceptance of BLE based Beacon technology”.
- As is the case with all “empirical research”, this study has some limitations that should be considered when “interpreting the results”. Participants were from “top and mid-level Hospital staff”, that is, the “managerial staff of Hospital”. GCS Hospital is a private Hospital, and the fact that “this study does not survey the Hospital staff from lower-level staff” which might not be fully representative of Hospital staff in GCS Hospital. Nevertheless, the results of “this study should be a positive starting point for research on acceptance of BLE based Beacon technology by Hospitals in India”.

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THANKS!