Research In Management Of Technology And Business Vol. 2 No. 2 (2021) 146–162

RMTB

Homepage: http://publisher.uthm.edu.my/proceeding /index.php/rmtb
e-ISSN : 2773-5044

The Adoption of Internet of Things in Urban Farming

Nurul Shafinaz Sa'don[1] **& Siti Aisyah Salim**[1,*]

[1]Department of Management and Technology, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA.

*Corresponding Author

DOI: https://doi.org/10.30880/rmtb.2021.02.02.012
Received 30 September 2021; Accepted 01 November 2021; Available online 01 Decemeber 2021

Abstract: Urban farming is one of the initiatives to supply urban residents with fresh vegetables and animal products. Further, with the right usage of technologies such internet of things (IoT) for urban activities could enhance the quality crops, reduced expenses and monitor plants and crops in real time. Limited of space is one major concern that widely discussed in past studies in relation to urban farming activities. However, discussion on the practicality and the usage of technologies in relation to urban farming activities still very lack in the context of Malaysia. Thus, the aim of this study is to identify the most dominant factor that influence IoT adoption in urban farming. Technology Acceptance (TAM) and Theory of Planned Behavior (TPB) have been adopted as theoretical foundation in this research. This study has collected 110 respondents among city residents in Johor Bahru. The sample was collected based on quantitative research method where self-administrated questionnaire has been applied. From the analysis, it shows that subjective norms factor has the most dominant influence towards IoT adoption in urban farming with average mean value 4.37. This study gives significant impact to several parties including (i) policy maker in order to promote and support urban farming in Malaysia; (ii) to farmers especially for giving the understanding on factors that could influence the adoption of IoT; (iii) to future researchers to study further about current technology and the importance of cultivation and also can be practice in future.

Keywords: Internet of things, Urban farming, Intention, Adoption

1. Introduction

In line with the emergence of new technologies, it is important for the city citizens to live in a resilient and sustainable environment (Wolfert *et al*., 2017). Thus, one of the sustainable initiatives that has been widely adopted is urban farming activities (Cabannes & Raposo, 2013). The implementation of urban farming is required since food security is essential and urban citizens becoming more condensed (Opitz *et al* ., 2016). The urbanization has brought the unwanted consequences such as

*Corresponding author: aisyahs@uthm.edu.my

reduction of fertile that lead to deforestation, air and water pollution, reduced drainage of the rainfall, and the creation of peri-urban areas (Orsini *et al*., 2013). There are several technologies such as big data, Internet of things (IoT), cloud computing have been innovated to support the operation of farming to be more productive, precise and sustainable (Elijah *et al*.,2018). These technologies have the potential to revolutionized traditional farming techniques and systems in farming to be more profitable, efficient, safe and environmentally friendly (Mteg and Msungu, 2013).

The use IoT in agriculture activities can improve the productivity, prices while maintaining sustainable development. IoT can overcome many problems that may be arising in agricultural field (Sundmaeker, 2016). As the use of IoT has shown significant improvement in agriculture industries, this effort has been extended to other related domain such as urban farming (Lecue *et al*., 2014). It is also been reported that IoT technology provides many benefits and thus has influenced more users to adopt this technology for farming purposes (Mwangi, Kariuki, 2015). As a result, IoT for farming is seen as a platform that been used frequently for side income, food security, food safety or to enhance the quality of the environment and greening the country (Thomaier and Siebert, 2014).

1.1 Research Background

In Malaysia, urban farming is one of the activities that has the potential to supply food for nourishment or related administrations inside or on the edges of urban regions (Goldstein, 2011). Kulak, *et al*.,(2013) defined urban farming is the process growing of cultivation plant around cities to give food in local population. Urban farming activities can improving the food security in low income communities (Rurangwa, E., & Verdegem, 2015). The existence technologies such as robots and sensor network has opened up new opportunities for applications in agriculture (Ali *et al*., 2016).

In developed country, IoT become interest in its potential to support poverty alleviation and the up liftmen of the living standards (Kopetz, 2011). In addition, IoT can helps in agriculture industry transforming and the farmers could resolve any challenges come for example, water shortage, limited availability of lands and easy to manage crops. The advantages of IoT can influence the life of the world with advanced industries and smart cities (Halgamuge *et al*,, 2019).Thus, there are several the use of IoT in agriculture has been making them more productive, precise and sustainable in developed to over overcome the problems (Teagasc, 2016).

1.2 Problem Statements

There are several topics has been discussed in past research related to urban farming activities (Aubry *et al*., 2012). Further, the use of advanced technology such as IoT has enhance the performance of urban farming activities (Lukman, 2017). Study by Vaishali *et al*. (2017), has pointed out that the use of IoT in urban farming can increase the efficiency of the crops as well as monitor the moist of the soil. Further, in another study by Savale *et al* (2015), have pointed out that urban farming activities could improve the fertilizer efficiency and reduce the side of IoT applications. Another study by Pierpaoli *et al*., (2013) has investigated factors that influence the adoption of technology like controlling system in urban farming. In that study, they have found that financial resources, security and the complexity of the technology and individual skills in use of technology as the main factors that lead to the adoption. In another study by Gao and Bai (2014), have found perceived ease of use and perceived of usefulness as factors that lead to the adoption of technology in urban farming.

It is undeniable that advance technology could provide several benefits towards urban farming activities (Otsuka, 2013). However, the use of advance technology in farming also been criticized (Walter *et al*.,2017). For example, some scholars have pointed out that using advance technology in farming is a complex process, high cost, and legal aspects that need to be considered. Though all these issues have been pointed out, but there is still lacking of studies that looking into each of these in details (Tukiman, 2017). According to Gubbi *et al*. (2013) to ensure the successful of urban farming activities,

it is a vital to understand the acceptance of IoT applications especially among city residents in Malaysia. Currently, study on IoT adoption and urban farming is still very limited. It is very important to understand factors that influence the adoption of IoT in urban farming (Poulsen *et al*.,2015). Thus, the aim of this research is to examine the factors that influence the adoption of IoT in urban farming and level of on the adoption of IoT in urban farming.

1.3 Research Questions

(i) What are the most dominant factors that influence IoT adoption in urban farming?
(ii) What is the level of intention towards IoT adoption in urban farming?
(iii) What is the relationship between the influencing factors and IoT intention of adoption in urban farming?

1.4 Research Objectives

(i) To identify the most dominant factors that influence IoT adoption in urban farming.
(ii) To examine the level of intention towards IoT adoption in urban farming.
(iii) To examine the relationship between the influencing factors and IoT intention of adoption in urban farming.

1.5 Significance of the Study

This study brings the significant to policy maker especially to government to promote and support urban farming in Malaysia. Second, this study will attract the farmers to use the current technology for farming. In addition, it also facilitates the new future research to study further about current technology and the importance of cultivation and also can be practice in future. Moreover, this study also can create a valuable reference to researchers.

1.6 Scope of the Study

The target sample for this research is the city residents which is live in Johor Bahru because they are falls in development regions. Hence, this research is to the relationship between the influencing factors and IoT intention of adoption in urban farming. The respondents of survey targeted in this research are city residents in Johor Bahru.

2. Literature Review

2.1 Urban Farming

Kulak *et al*., (2013) define urban farming as a process of cultivation plant around cities to give food in local population. While, Salim *et al*. (2019) define urban farming as an activity that happen in city area by city dwellers to get fresh food and get additional income. The activity of urban farming can be done in small or large areas within city area, community garden, balconies, indoor farms and greenhouses (Goldstein, 2011). Urban farming received attention from local governments throughout the developing population in city (Hamilton *et al*., 2014). The activity of urban farming has become gradually popular as demand for green development increases (Tukiman, 2017). Urban farming contributes to the improvement of maintainability in cities by expanding natural quality of the crop yields (Rezai *et al*., 2016). According to Terano *et al*. (2017) positive perception, confidence in practicing urban farming and influenced by societal environment are factors that influences the adoption of urban farming. Hence, there are several initiatives introduced to urban farming especially to solve the problems of insufficient sharing of information (Yan and Tan, 2016). Study by Yan and Tan (2016) found that the internet of things (IoT) is one effective method to solve the problems regarding the farming products.

2.2 Internet of Things (IoT)

IoT is a concept of computing that link the computer network (Singh, 2020). According to Vermesan and Friess (2014), IoT enable to be connected anytime and anywhere. The adoption of IoT has been extended to urban farming industry which include every aspects of our life. In addition, with the advancement of new technology like internet, big data and smart phone, the activity of farming can be done through electric monitoring of crops, as well as related to environmental (Jayaraman *et al* ., 2016). A study by Gao and Bai (2014), found that factors contribute the IoT in urban farming are trust, social influence, perceived enjoyment and perceived behavioral intention to use IoT technology. These included the advantage of the innovation, comparability to existing product, effecting how easy it is to adopt, its complexity or simplicity, including perceptions of this, its trialability or testability, in terms of the opportunity to experiment with innovation and finally, observability, in terms of how easy it is (Long, *et al*.,2016).

2.3 Urban Farming and Internet of Things

IoT is a framework of interrelated computing gadgets, computerizes machines given with one of a kind identifiers and the capacity to exchange information over a organize without requiring human interaction (Halgamuge *et al*., 2019). The adoption of IoT in urban farming has provide significant improvement among city dwellers especially in Malaysia. According to Arvind *et al*. (2017), the use of IoT in urban farming activities could improve the process of plantation to be more efficient and effective as all information will be stored in electronic devices (Yoon *et al*., 2018). IoT could also become the solution for smart agricultural and automated farming. The automation systems could improve the efficiency their labor manpower (Mekala and Viswanathan, 2017). There are several studies discussed on the effectiveness of IoT for urban farming purposes (Takekar and Takekar, 2017; Moon *et al*., 2017).

IoT gives positive impact towards our daily lives (Gao, 2015). Several benefits of IoT in farming activities have been reported including monitoring, improvement in the use efficiency of inputs (soil, water, fertilizers and pesticides), reduced cost of production, and protection of the environment (Patil *et al*., 2012). The conveniences rendering an emerging trend among the users and it become one of the major factors contributed this activity (Weinberg *et al*.,2015). There are several factors that influence the adoption of IoT for urban farming including farm size (Kariuki (2019), human capital or recognized as the farmers' education (Keelan *et al*., 2014) and many more.

2.4 Theoretical Background

There are few theories widely used for explaining the intention of adoption such as Technology Acceptance Model (TAM) (Davis, 1986), Theory of Planned Behavior (TPB) (Ajzen,1991), (UTAUT) (Venkatesh *et al*,.2003), Diffusion of innovation (DOI), DeLone and McLean IS Success Model (Delone and McLean 2003) and few more. However, only few theories are relevant with IoT particularly for urban farming context. In this study, TAM and TPB have been selected to examine the relationship between success factors and intention to adopt of IoT in urban farming.

2.5 Conceptual Framework

The process of conceptualization the research framework and factors that lead to intention of adoption is influenced by the work of Jurkenbeck *et al*., (2019). Their study has discussed factors that lead to intention of technology adoption in vertical farming. In order to explain this scenario, Jurkenbeck *et al*., (2019) have adopted TAM and TPB theory. TAM will be used in this study to explain the perceived usefulness in technology. While TPB will be used in this study to explain the perceived behavior control, subjective norms, and attitude toward adoption. The aim of conceptual framework is to show the main components comprise in the framework which include the independent variable and dependent variable of this study. This study has one dependent variable which is intention to adopt and four independent variables which is subjective norms, perceived usefulness, perceived behavior control and attitude toward adopt will be further elaborated.

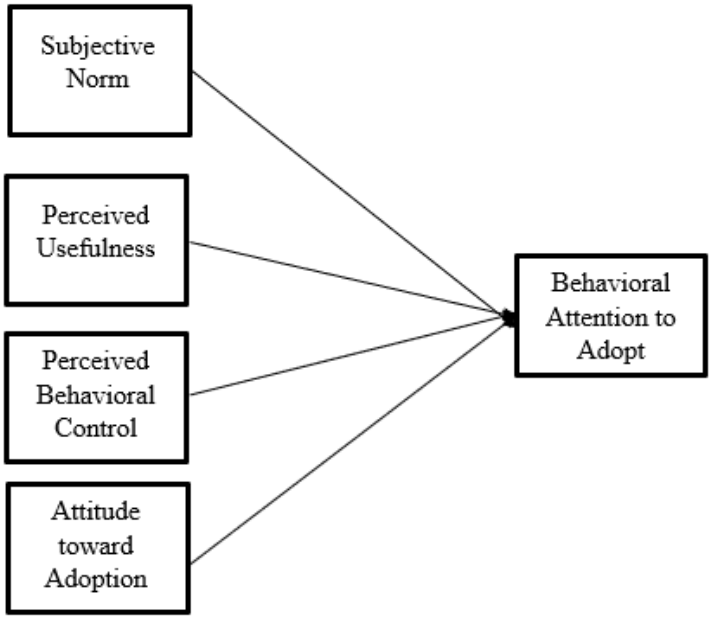

Figure 1: Conceptual framework

(a) Subjective Norm

Subjective norm is a social factor, which corresponds to the perceived social pressure to perform or not perform the behavior. According to Hou and Hou (2019), it is symbolizes of influence on someone or in the organization and is also an important system of one's decisions such as from, peers, family and friends. Some researchers have been said, the consumer will have a higher intention to use the technology in farming, when they got their positive perceptions in their own ability to implement in practice on their farms. According to Borges, *et al*.,(2014), attitude and perceived behavioral control are the main factors that influence the intention of adoption.

(b) Perceived Usefulness

Perceived usefulness is the degree to which the user believes that the system usage would enrich their performance and lifestyle (Davis FD., 1989). According to Flett *et al*.(2004), perceived of usefulness allows farmers focus on their particular needs and could improve the financial status of the farm. Some researchers have identified the positive relationship between IoT products or services adoption rates and perceptions would facilitate in their daily life (Gao, L.; Bai, 2014).

(c) Perceived Behavioural Control

Perceived behavioral control refers to the ease or difficulty perceived by the individual to perform by the individual to perform the behavior (Ajzan,1991). According to Borges, *et al*.,(2014), perceived behavioral control is another factor that alleviate people's involve in seeking relevant information in technology and its explain a few users' perception if they have the essential resources, potentiality, and sense of control in successfully performing the behavior. Perceived behavior control has a huge influence in the behavioral intention to adopt instead of they are does not impact on the attitude toward adoption.

(d) Attitude toward Adoption

Attitude is a measurement to the individual whether is favorable or unfavorable to the achievement of one's behavior (Mi, 2013). Individuals from their attitude based on their perception of what may be true about a particular may based on information, knowledge to the subject sometimes supported

believes (Willock *et al*.,1999). According to the Bearth *et al*.(2014) the attitude toward adoption positively affects the behavioral intention to adopt. In previous research, the consumer aware the practice of technology in farming due to perceived security of food.

(e) Intention to Adopt

Few studies related to intention of IoT in urban farming have been done by research. There are a few factors that will influence the acceptance of internet of things especially the social influence. Social influence plays an importance role in initial stage of process or diffusion to adopt the internet of things. According to Trust (2018), factors of ease of use and perceived usefulness may influence the intention to adopt internet of things. According to Jurkenbeck *et al*.(2019), subjective norms, perceived usefulness, perceived behavioral control, attitude to adoption are the main factors that influence the intention of adoption.

2.6 Hypothesis

The research hypotheses are formulated from the research questions. Of utmost interest in the present study is the investigation of question: "What is the relationship between the influencing factors and IoT intention of adoption in urban farming?". To understand the issue, we explore the variables through the lens of Technology Acceptance Model (TAM) by (Davis, 1986)) and Theory of Planned Behavior (TPB) by Ajzen (1991). The hypotheses development for this research was based on social influence towards intention to adopt internet of things in urban farming. Further, we applied the relationship of TAM variables to context of this research, which posits the intention to adopt internet of things in urban farming is determined by subjective norms, perceived usefulness, perceived behavioral control, and attitude to adoption. Based on these arguments, it was hypothesized that:

H1: There is a significant relationship between subjective norm and the adoption of IoT in urban farming.

H2: There is a significant relationship between perceived usefulness and the adoption of IoT in urban farming.

H3: There is a significant relationship between perceived behavioral control and the adoption of IoT in urban farming.

H4: There is a significant relationship between attitude toward adoption and the adoption of IoT in urban farming.

3. Research Methodology

3.1 Research Design

In this research, both descriptive research and quantitative research will be used. Descriptive research provides a detailed and highly accurate picture of the research. Besides, it also helps to locate new data that contradict past data and create a set of categories or classify types. Then, step or stages of sequence can be clarifying and report on the background or context of situation. Quantitative research being used in this study because method is fast and can cover wide range and situation by picking sample to present the population that desired to study. Moreover, the data collected through questionnaire survey and secondary data will provide reliable result (Ahmad, 2018).

3.2 Sampling Method

This study will be conducted in developing city which is in Johor Bahru. The population of the study which is consisted the people in Johor Bahru are estimate 1494800 peoples. According to Sekaran (2000), population is the entire group of individuals that researchers want to study. Based on the sampling schedule Krejcie & Morgan (1970), this study has set a total of 384 respondents to answer the questionnaires that will be distributed.

3.3 Research Instrument

This research will use quantitative method and the suitable instrument that will be used is questionnaire form. Instrument study is method used to get and gather research information. The questionnaire is one of the tools of quantitative method for gathering structured data from individuals. The questionnaire that distributed to the respondents is close-ended format. The questionnaire is divided into two section such suction A and section B. The section A will be explained the background of the respondents. The section B will ask the question about intention of adoption.

3.4 Data Analysis

All collected data obtained arranged into a systematic and easy to understand. Analysis of data had taken part in order to identify the finding of the research and to establish whether this research will be meeting the research objectives. Data which collect from the primary sources which was questionnaire will be analyzed by using the descriptive analysis method and correlation analysis.

(a) Descriptive Analysis

Descriptive analysis is used to see percentage and average mean value and frequency. In this study, researcher will use descriptive analysis in relation to know how to obtain the population information from the sample. Statistical analysis method that used to analyze the data for this research is use the SPSS software. It a program that provide various ways to rapidly examine data and test scientific hunches Further, the research can made clarification on the basic results and data information from percentage and mean for the research.

(a) Correlation Analysis

Correlation analysis is used to access the relationship between the variables (Akhilesh, 2019). In this study, researcher will use correlation analysis in relation to know how to measures the extent of correspondence between the variables. Pearson's correlation coefficient method is use to express the strength of the relationship between the variables since the normality test showed that the data was not normally distributed (Patricks *et al*., 2018).

4. Results and Analysis

4.1 Response Rate

In this study, the selected respondents are city residents in Johor Bahru that consists 14, 94,800 peoples. According to Krejcie and Morgan's (1970) on calculating the sample size based on population number, this study required at least 384 respondents to answer the questionnaire. Thus, the questionnaire survey was distributed to the respondents but only 110 sets were getting back. Based on that, the response rate of this study is 29 percent.

(a) Pilot Study

Pilot study is small scale versions of planned investigations and been conducted to test the reliability of the questionnaire in research (Doody & Doody, 2015). A pilot study often provides ideas, approaches and clues that may have been overlooked before conducting the real study (Lang *et al*.,2016). By doing pilot study, it can increases the chances of getting clearer findings as well as eliminate question that are likely to mislead in the main research (Teare *et al*.,2014). Thus, a total 25 questionnaire has been distributed to urban citizen who has been doing farming in Johor Bahru. The result of the questionnaire was analyzed by using SPSS.

Table 1: Cronbach's alpha value for 25 respondents

Factors	Cronbach's Alpha	No. Item
Subjective Norms	0.734	2
Perceived Usefulness	0.723	4
Perceived Behavioral Control	0.797	2
Attitude Toward Adoption	0.704	3
Intention to Adopt	0.785	2

Table 1 shows the summary of reliability test for this study. The Cronbach's alpha for subjective norms is 0.734, Cronbach's alpha for perceived usefulness is 0.723, for perceived behavior control is 0.797 and for attitude toward adoption is 0.704. While for intention to adopt, the Cronbach's alpha is 0.785. The result shows that the reliability level Cronbach's alpha of the questionnaire is acceptable as the value of each construct is greater than 0.7. With the acceptable result obtained from pilot study, researcher can proceed with collecting data with the actual study.

(b) Actual Study

The actual study conducted once the result from the pilot is valid and reliable. Table 2 shows the result of reliability test conducted for actual study for each variable. For this study, 110 citizens from Johor Bahru have been used to get their respondents.

Table 2: Reliability test (actual study)

Factors	Cronbach's Alpha	No. Item
Subjective Norms	0.715	2
Perceived Usefulness	0.742	4
Perceived Behavioral Control	0.782	2
Attitude Toward Adoption	0.708	3
Intention to Adopt	0.715	2

Based on the Table 2, the Cronbach's Alpha for subjective norms is 0.715. While for perceived usefulness is 0.742, for perceived behavioral control, the Cronbach's alpha is 0.782, and for attitude toward adoption, the Cronbach's alpha is 0.708. Lastly, for intention to adopt, the Cronbach's alpha is 0.715. The result shows that the reliability level of the questionnaire is acceptable as the value for each are more than 0.7, which means that the research instrument that being used are reliable.

4.2 Descriptive Analysis (Demographic)

This section gives the overview of demographic information of respondent. Few questions in relation with gender, race, age, having experience using technology for farming purposes has been asked under this section. For the purpose illustrating general information of the respondent, only gender and using technology for faming activities will only be reported.

(a) Gender

Table 3 illustrates the percentage of respondents based on their gender. From the result it shows majority of the respondents are male with 53.6 percent while the rest are female respondents.

Table 3: Demographic information (gender)

Gender	Frequency	Percentage (%)
Female	51	46.4
Male	59	53.6
Total	110	100

(b) Using Technology

Table 4 show more than 10.9 percent of respondents have answered yes for the following question *"Is your technology currently help your farming activities?"* . From the table it also shown that the 12 respondents have selected agree with the statement while 98 respondents disagree with the statement.

Table 4: Using technology for farming

Is your technology currently help your farming activities?		
Yes	12	10.9
No	98	89.1
Total	110	100

4.3 Descriptive Analysis (Variable)

In this section, descriptive analysis is used to examine the characteristics of individual variables. Thus, the researcher has examined the data to describe the mean and standard deviation related all variables which are subjective norms, perceived usefulness, perceived behavior control, attitude toward adoption and intention to adopt. Besides, this analysis is an efficient way to differentiate each part in the mean distribution based on the Likert Scale to measure the level of measurement of the center of tendency for each question item in the questionnaire.

(a) Subjective Norms

From the result it shows that the highest mean value for subjective norms variable is for question 3 with statement *"The government will give tax exemption if I'm use IoT for urban farming activities"* (M=4.45, SD=0.72). However, question 1 the lowest mean value with statement *"My neighbor will support me if I am using IoT for urban farming activities"* (M=4.29, SD=0.70). Even though the question 1 has the lowest mean value, but still have the medium range position. In this study, the average mean value of subjective norms is 4.37.

(b) Perceived Usefulness

From the result it shows that the highest mean value for perceived usefulness variable is for question 2 with statement *"The use of IoT for urban farming is environmental friendly"* (M=4.26, SD=0.81). However, question 1 the lowest mean value with statement *"The use of IoT in urban farming contribute to regional food production"* (M=4.17, SD=0.85). Even though the question 1 has the lowest mean value, but still have the medium range position. In this study, the average mean value of perceived usefulness is 4.20.

(c) Perceived Behavioural Control

From the result it shows that the highest mean value for perceived behavioral control variable is for question 1 with statement *"I'm confident IoT can increase my farming production"* (M=4.07, SD=0.80). However, question 3 the lowest mean value with statement *"The space in my house area*

influence my decision towards IoT adoption in urban farming" (M=4.03, SD=0.67). Even though the question 3 has the lowest mean value, but still have the medium range position. In this study, the average mean value of perceived behavioral control is 4.05.

(d) Attitude toward Adoption

From the result it shows that the highest mean value for attitude variable is for question 3*"I am positive toward the adoption of IoT for urban farming"* (M=4.27, SD=0.49). However, question 1 the lowest mean value with statement *"I am aware of the practice of IoT adoption in urban farming"* (M=4.01, SD=0.61). Even though the question 1 has the lowest mean value, but still have the medium range position. In this study, the average mean value of for attitude toward adoption is 4.13.

(e) Intention to Adopt

From the result it shows that the highest mean value for intention to adopt variable is for question 3 *"The use of IoT is the systematic device in urban farming to adopt"* (M=4.45, SD=0.72). However, question 1 the lowest mean value with statement *"In future, I will adopt IoT for my urban farming activities"* (M=4.29, SD=0.70). Even though the question 1 has the lowest mean value, but still have the medium range position. In this study, the average mean value of for intention to adopt is 4.37.

4.4 Normality Test

Normality test is needed before proceeding to the correlation test. According to Asghar and Salleh (2006), normality test is used to determine whether the study population is normally distributed, or not. If the data is normally distributed, then the data parametric test is used by conducting Pearson correlation test. However, if the data is not normally distributed, then the non-parametric test will be conducted using Spearman correlation test. Besides, researcher needs to use whether Kolmogrov-Smirnov or Shapiro-Wilk test to determine the distribution of data normality. From the analysis, it shows the value of all variables have p value <0.005 which are 0.000 and 0.001. Hence, this data is not normal and non-parametric test of Spearman's Rho correlation test will be used to describe the relationship between two variables and to achieve the objectives of the study.

4.5 Correlation Analysis

According to Gogtay and Thatte (2017), correlation is used to estimate the strength of relationship between two or more variables. Bivariate correlation is known as one of the simplest form of quantitative analysis (Bonett and Wright, 2015). In this study, researchers have used Spearman's Rho correlation test to achieve the goal of the study as the data collection is not normal distributed. According to Dancy and Reiny (2004) , if the correlation coefficient is less than 0.10 then the correlation strength is considered as negligible correlation. In addition, if the correlation coefficient is between 0.10 and 0.30, then the strength of the correlation is weak. Correlation's strength is considered moderate if the correlation value is between 0.40 and 0.60. While, if the correlation coefficient is between 0.70 and 0.90, the strength of the relationship is considered strong. The correlation coefficient is considered as strong if the coefficient value is 0.90 and above, the strength of the relation is a very high level.

Table 5: The interpretation of Spearman rho correlation coefficient

Correlation	Strength of Relationship
1	Perfect
0.7 - 0.9	Strong
0.4 – 0.6	Moderate
0.1 – 0.3	Weak

4.6 Hypothesis Testing Analysis

Table 6 shown the result of hypothesis tests. According to the result, subjective norms, perceived usefulness, perceived behavioral control and attitude to adopt factors has correlation with the dependent variable, intention to adopt but subjective norms is the dominant factor among others. As conclusion, the correlation coefficient between subjective norms and intention to adopt shows that there is a positive significant relationship between theses correlation. Meanwhile, there is less significant between perceived behavior control and intention to adopt internet of things in urban farming.

Table 6: Level of coefficient correlation

	Hypothesis	Correlation Coefficient	Level
H_1	There is a significant relationship between subjective norms and intention to adopt.	1.000**	Positive relationship
H_2	There is a significant relationship between perceived usefulness intentions to adopt.	0.283 **	Positive relationship
H_3	There is a significant relationship between perceived behavior control and intention to adopt.	0.141	Less Significant relationship
H_4	There is a significant relationship between attitude towards adoption and intention to adopt.	0.149	Less Significant relationship

5. Discussion, Recommendation and Conclusion

5.1 Discussion

As a whole, this study has addressed each research question and subtopic discussed the objectives have been carried out to identify the most dominant factors that influence IoT adoption in urban farming, to examine the level of intention towards IoT adoption in urban farming and to examine the relationship between the influencing factors and IoT intention of adoption in urban farming. According to the result, subjective norms, perceived usefulness, perceived behavioral control and attitude to adopt factors has correlation with the dependent variable, intention to adopt but subjective norms is the dominant factor among others. As conclusion, the correlation coefficient between subjective norms and intention to adopt shows that there is a positive significant relationship between theses correlation. Meanwhile, there is less significant between perceived behavior control and intention to adopt internet of things in urban farming.

(a) Research Objective 1

Table 7: Factors that influence the adoption of IoT in urban farming

No.	Influencing Factors	Average Mean Score	Level
1.	Subjective Norms	4.38	High
2.	Perceived Usefulness	4.20	Medium
3.	Perceived Behavior Control	4.05	Medium
4.	Attitude to Adopt	4.12	Medium

In this study, descriptive analysis has been used to describe the average mean score. Table 7 shows the significant factors of average mean score for each variable that have been measured. Based on these four factors of intention of the adoption, the subjective norms and perceived usefulness is at high level

of means while perceived behavior control and attitude to adopt has medium mean. This result was dependable with the earlier study,

(b) Research Objective 2

Table 8: Intention level towards IoT adoption in urban farming

No.	Item of Intention of Adoption	Average Mean Score	Level
1.	In future, I will adopt IoT for my urban farming activities.	4.29	Medium
2.	I will recommend to other farmers to use IoT for urban farming activities.	4.37	Medium
3.	The use of IoT is the systematic device in urban farming to adopt.	4.45	High

Table 8 illustrates the findings for level of intention towards IoT adoption in urban farming. The findings show the overall level of factors that influence intention towards IoT adoption in urban farming is at medium level and statement "*The use of IoT is the systematic device in urban farming to adopt"* is at high level. The results shows that subjective norms, perceived usefulness, perceived behaviour control and attitude to adopt are strong factors that influence intention towards IoT adoption in urban farming.

Based on the result, most of the respondents agreed that IoT is the systematic device in urban farming to adopt which is at high mean level. However, they will recommend to other farmers to use IoT for urban farming activities and they will adopt IoT for my urban farming activities in future are at medium mean level. Overall, respondents in this study have a very positive feedback when they use IoT in urban farming which can conclude that the level of intention towards IoT in urban farming is between medium and high level.

(c) Research Objective 3

Based on the Table 6 the result shows that there is a positive relationship between subjective norms and intention to adopt. As a whole, only one hypothesis has been accepted which is H_1. This is inline with finding from Hou and Hou (2019) that found subjective norms have positive relationship with intention of the adoption in their study.

5.2 Limitation

There are few limitations identified from this study. First, the selection of the respondents. Since this study has chosen respondents which are city dwellers from Johor Bahru, Johor, the result is not represent the whole Malaysia population. Second, as this research used quantitative method in collecting data, the information gathered from the respondent are very specific to questions that has been designed in the survey questionnaire. Thus, the answer given are quite generic and having variation and rigor.

5.3 Recommendation

Based on the results of this study, a few suggestions can be made. First, recommendation is the target population of respondents not only focus urban dwellers in Johor Bahru. it can expand in any develop region. Besides, the questions of questionnaire that distribute to the respondents should be simple and easy to understand by the respondents. This can more easily for respondents to answer the questionnaire based on their understanding. For future research, the researchers can also use other type of methodologies such as qualitative method to examine the adoption of IoT in urban farming with the technology outcomes such as IoT adoption of IoT satisfaction.

5.4 Conclusion

As conclusion, the level of subjective norms toward intention of adoption in urban farming is in high range level. Besides, the level of intention towards IoT adoption IoT in urban farming is between medium and high range level. In addition, this study also states there is a significant relationship between the subjective norms and intention of IoT adoption. The result shows that only subjective norms have positive relationship towards intention of IoT adoption. While, perceived usefulness, perceived behavior control and attitude to adopt have less significant relationship towards intention of IoT adoption. Therefore, all three objectives that have been achieved. Hence, this research can contribute to enhance the knowledge for the education sector to understand the respondents' perceptions on influence dimensions towards intention of IoT adoption.

Acknowledgement

This research is part of Technology & Innovation Management Focus Group activities in developing student competencies. Special thanks to the Faculty of Technology Management and Business and UTHM in general.

References

Adnan, N., Nordin, S. M., Rahman, I., & Noor, A. (2017). The impacts and visions of the Green Fertilizer Technologies (GFT). *Adoption Behaviour of Among Malaysian Paddy Farmers, World Journal of Science, Technology and Sustainable*, *14(4),* 336–354.

Affair, D. of E. and S. (2013). *Sustainable Development Challenges*. United Nation.

A. Moon and J. Kim and J. Zhang and S. Son. (n.d.). "Lossy compression on IoT big data by exploiting spatiotemporal correlation,." *In IEEE High Performance Extreme Computing Conference (HPEC)*.

Adnan, N., Nordin, S. M., Rahman, I., & Noor, A. (2017). The impacts and visions of the green fertilizer technologies (GFT). *Adoption Behaviour among Malaysian Paddy Farmers, World Journal of Science, Technology and Sustainable*, *14(4),* 336–354.

Ahmad, M. (2018). "Online Shopping Behavior among University Students: Case Study of Must University". *Advances in Social Sciences Research Journal,*.

Akhilesh. (2019). What Is the Correlation Coefficient? Retrieved from https://www.investopedia.com/terms/c/correlationcoefficient.asp

Akudugu, M., Guo, E., Dadzie, S. (2012). Adoption of Modern Agricultural Production Technologies by Farm Households in Ghana: What Factors Influence their Decisions? Journal of Biology, Agriculture and Healthcare, *2(3)*.

Aubert, B. A., Schroeder, A., & Grimaudo, J. (2012). IT as enabler of sustainable farming: An empirical analysis of farmers' adoption decision of precision agriculture technology. *Decision Support Systems, 5*, *54*((1)), 2012.

Aubry, C., Ramamonjisoa, J., Dabat, M. H., Rakotoarisoa, J., Rakotondraibe, J., & Rabeharisoa, L. (2012). Urban agriculture and land use in cities: an approach with the multi-functionality and sustainability concepts in the case of Antananarivo (Madagascar). *Land Use Policy, 29*(2), 429-439.

Bagozzi, R. P., Davis, F. D., & Warshaw, P. R. (1992). The self-regulation of attitudes, intentions, and behaviour. *Social Psychology Quarterly, 55(2),* 178–204.

Bearth, A.; Cousin, M.-E.; Siegrist, M. (2014). The consumer's perception of artificial food additives: Influences on acceptance, risk and benefit perceptions. *Food Qual.*, *38*, 14–23.

Besthorn, F. H. (2013). Vertical farming: Social work and sustainable urban agriculture in an age of global food crises. *Australian Social Work, 66*(2), 187–203.

Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior, 36*(1), 3–15.

Borges, J. A. R., Lansink, A. G. O., Ribeiro, C. M., & Lutke, V. (2014). Understanding farmers' intention to adopt improved natural grassland using the theory of planned behavior. *Livestock Science, 169,* 163-174.

Business Dictionary. (2017). "What is data collection? Definition and meaning-

BusinessDictionary.com". Retrieved from http://www.businessdictionary.com/definition/data-collection.html

C. Yoon and M. Huh and S. Kang and J. Park and C. Lee. (2018). "Implement smart farm with IoT technology,." *In 20th International Conference on Advanced Communication Technology (ICACT),*.

Cabannes, Y., & Raposo, I. (2013). Peri-urban agriculture, social inclusion of migrant population and Right to the City: *Practices in Lisbon and London. City, 17*((2),), 235-250.

Chen, M., Liu, W., & Tao, X. (2013). Evolution and assessment on China ' s urbanization 1960 e 2010 : Under-urbanization or over-urbanization ? *Habitat International*, *38*, 25–33. https://doi.org/10.1016/j.habitatint.2012.09.007

Cook, E. A., & Lara, J. J. (2012). Global dynamics of urban landscapes. *In Remaking Metropolis*, 37–51.

Davis, F. D. A. (1986). A technology acceptance model for empirically testing new end user information systems :theory and results. *Ph. D. Dissertation ,MIT Sloan School of Management , Cambridge , MA ,1*.

Delone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: a ten-year update. *Journal of Management Information Systems, 19*(4), 9-30.

Doody, O., & Doody, C. M. (2015). Conducting a pilot study: Case study of a novice researcher. *British Journal of Nursing, 24*((21)), 1074-1078.

Eigenbrod, C., & Gruda, N. (2015). Urban vegetable for food security in cities. A review. *Agronomy for Sustainable Development, 35*(2), 483–498.

Elijah, O., Rahman, T. A., Orikumhi, I., Leow, C. Y., & Hindia, M. N. (2018). An overview of Internet of Things (IoT) and data analytics in agriculture: *Benefits and Challenges. IEEE Internet of Things Journal, 5(5),* 3758–3773.

Flett, R., Alpass, F., Humphries, S., Massey, C., Morriss, S., & Long, N. (2004). The technology acceptance model and use of technology in New Zealand dairy farming, *80*, 199–211. https://doi.org/10.1016/j.agsy.2003.08.002

G. Arvind and V. Athira and H. Haripriya and R. Rani and S. Aravind. (n.d.). "Automated irrigation with advanced seed germination and pest control,. *In IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR)*.

Gao, L., & Bai, X. (n.d.). A unified perspective on the factors influencing consumer acceptance of internet of things technology. *Asia Pacific Journal of Marketing and Logistics*, *26(2),*(211–231).

Gao, L.; Bai, X. (2014). A unified perspective on the factors influencing consumer acceptance of internet of things technology. *Asia Pac. J. Mark. Logist.*, *26,* 211–231.

Gao, L. (2015). A unified perspective on the factors influencing consumer acceptance of internet of things technology. https://doi.org/10.1108/APJML-06-2013-0061

Gartner Press Release. (2013). Internet of Things Installed Base Will Grow to 26 Billion Units by 2020. *Attivo Networks*. Retrieved from https://attivonetworks.com/gartner-says-the-internet-of-things-installed-base-will-grow-to-26-billion-units-by-2020/

Gershenfeld, N. and Vasseur, J. P. (2014). "As objects go online: the promise (and pitfalls) of the Internet of Things." *Foreign Affairs, Vol. 93*(No. 2), 60–67.

Gogtay, N. J., & Thatte, U. M. (2017). Principles of correlation analysis. *Gogtay, N. J., & Thatte, U. M.*, *65*((3)), 78-81.

Goldstein, M. (n.d.). Urban agriculture: a sixteen city survey of urban agriculture practices across the country., Page 4.

Halgamuge, M. N., Wirasagoda, H. A. H. S., & Syed, A. (2019). Adoption of the Internet of Things (IoT) in Agriculture and Smart Farming towards Urban Greening : A Review, (April), 10–28. https://doi.org/10.14569/IJACSA.2019.0100402

Hansson, H., Ferguson, R., Olofsson, C., & Rantamäki-Lahtinen, L. (2013). Farmers' motives for diversifying their farm business–The influence of family. *Journal of Rural Studies, 32*, 240-250.

Harry, D. (2019). "What is Primary Research?" Purdue Online Write Lab. Retrieved from https://owl.purdue.edu/owl/research_and_citation/conducting_research/conducting_primary_research/index.html

Hou, J., & Hou, B. (2019). Farmers ' Adoption of Low-Carbon Agriculture in China : An Extended

Theory of the Planned Behavior Model. https://doi.org/10.3390/su11051399
Islam, R., & Chamhuri, S. (2016). The Analysis of Urban Agriculture Development in Malaysia The Analysis of Urban Agriculture Development in Malaysia, (March 2012).
Jain, S., & Angural, V. (. (2017). Use of Cronbach's alpha in dental research. *Medico Research Chronicles, 4*(3), 285–291.
Jayaraman, P., Yavari, A., Georgakopoulos, D., Morshed, A., & Zaslavsky, A. (2016). Internet of things platform for smart farming. : *: Experiences and Lessons Learnt. Sensors, 16(11)*, *18*.
Johnston, M. P. (2017). Secondary data analysis: A method of which the time has come. *Qualitative and Quantitative Methods in Libraries, 3*(3), 619–626.
Jürkenbeck, K., Heumann, A., & Spiller, A. (2019). Sustainability Matters : Consumer Acceptance of Di ff erent Vertical Farming Systems, (Figure 1), 1–21.
Kariuki, S. (2019). Factors determining adoption of new agricultural technology by smallholder farmers in developing countries Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries, (September).
Keelan, C., Thorne, F., Flanagan, P., Newman, C. (2014). Predicted Willingness of Irish Farmers to Adopt GM Technology. *The Journal of Agrobiotechnology Management and Economics*, *12(3)*.
Khatri-Chhetri, A., Aggarwal, P. K., Joshi, P. K., & Vyas, S. (2017). Farmers' prioritization of climate-smart agriculture (CSA) technologies. *Agricultural Systems, 151*, 184-191.
Kim Steele. (2017). *Urban farming*. The Elemental Group.
Krejcie, R. V., & Morgan, D. W. (n.d.). Determining sample size for research activities. *Educational and Psychological Measurement, 30(3)*, 607–610.
Kulak, M., Graves, A., & Chatterton, J. (2013). Reducing greenhouse gas emissions with urban agriculture: a life cycle assessment perspective. *Landscape and Urban Planning, 111,* 68-78.
Lang, G., Stengård, E., & Wynne, R. (2016). Developing a scale measuring perceived knowledge and skills dimensions for mental health promotion: a pilot test using a convenience sample. *The Journal of Mental Health Training, Education and Practice.*
Lavison, R. (2013). Factors Influencing the Adoption of Organic Fertilizers in Vegetable Production in Accra, Msc Thesis, Accra Ghana.
Long, T. B., Blok, V., & Coninx, I. (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe : evidence from the Netherlands ,. *Journal of Cleaner Production*, *112*, 9–21. https://doi.org/10.1016/j.jclepro.2015.06.044
M. Mekala and P. Viswanathan. (2017). "A novel technology for smart agriculture based on IoT with cloud computing,." *In International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC),*.
Mi, S. (2013). China Low Carbon Modern Agriculture Development: From Views of Carbon Footprint Calculation and Applicable Mitigation Technology Application., (5,), 103–109.
Mignouna, B., Manyong, M., Rusike, J., Mutabazi, S., & Senkondo, M. (2011). Determinants of Adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya: *AgBioforum, 14(3),* 158-163.
Mougeot, L.J.A. (2012). The Social, Political and Environmental Dimensions of Urban Agriculture., 235-253.
Mtega, W. P., & Msungu, A. C. (2013). Using information and communication technologies for enhancing the accessibility of agricultural information for improved agricultural production in Tanzania. *The Electronic Journal of Information Systems in Developing Countries, 56*((1),), 1-14.
Mwangi, M., & Kariuki, S. (2015). Factors determining adoption of new agricultural technology by smallholder farmers in developing countries. J. *Journal of Economics and Sustainable Development, 6*(5).
Omolara, F., Bamigboye, F., & Ademola, O. (2016). Internet of Things (IoT): Its Application for Sustainable Agricultural Productivity in Nigeria Internet of Things (Iot): It ' s Application For Sustainable Agricultural Productivity In Nigeria, (April).
Opitz, I., Berges, R., Piorr, A., & Krikser, T. (2016). Contributing to food security in urban areas: Differences between urban agriculture and peri-urban agriculture in the Global North. *Agriculture and Human Values, 33*((2)), 341–358.
Orsini, F., Kahane, R., Nono-Womdim, R., & Gianquinto, G. (2013). Urban agriculture in the developing world: a review. *Agronomy for Sustainable Development, 33*(4), 695-720.

Otsuka, K. (2013). Food insecurity, income inequality, and the changing comparative advantage in world agriculture. *Agricultural Economics, 44*(1), 7-18.

Patil, V. C., Al-Gaadi, K. A., Biradar, D. P., & Rangaswamy, M. (n.d.). Internet of things (Iot) and cloud computing for agriculture: An overview. *Proceedings of Agro-Informatics and Precision Agriculture*, *2012*, 292-296.

Patricks S.,Christa, B & Lothar, S. (2018). Correlation Coefficients: Appropriate Use and interpretation., *126*(5), 1763–1768.

Rasmuna Mazwan Muhammad and Mohd Rashid Rabu. (2015). The Potential of Urban Farming Technology in Malaysia: Policy Intervention. Retrieved from http://ap.fftc.agnet.org/ap_db.php?id=534&print=1

Rezai, G., Shamsudin, M. N., & Mohamed, Z. (2016). Urban agriculture: a way forward to food and nutrition security in Malaysia. *Procedia-Social and Behavioral Sciences, 216*, 39–45.

Richard Heinberg. (n.d.). We are exceeding Earth's carrying capacity. Denying it is suicidal. *QUARTZ*.

Rurangwa, E., & Verdegem, M. C. (2015). Microorganisms in recirculating aquaculture systems and their management. *Reviews in Aquaculture, 7(2),* 117-130.

S. Ruengittinun and S. Phongsamsuan and P. Sureeratanakorn. (2017). "Applied internet of thing for smart hydroponic farming ecosystem (HFE),." *In 10th International Conference on Ubi-Media Computing and Workshops (Ubi-Media),*.

S. Takekar and S. Takekar. (n.d.). "Plant and taste to reap with Internet of Things implementation of IoT in agriculture to make it a parallel industry,." *In International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC),*.

S. Vaishali and S. Suraj and G. Vignesh and S. Dhivya and S. Udhayakumar. (2017). "Mobile integrated smart irrigation management and monitoring system using IOT,." *In International Conference on Communication and Signal Processing (ICCSP)*.

Salim, S. A., Alaa, M., Yusof, Z. M., Farhana, L., Siti, I., & Salim, H. (2019). Urban Farming Activities in Southeast Asia : A Review and Future Research Direction, *2010*, 1–5.

Sam Meredith. (2018, May). Two-thirds of global population will live in cities by 2050. *CNBC*.

Singh, S. (2020). Business Opportunities & Reference Architecture for E-commerce. *2015 International Conference on Green Computing and Internet of Things (ICGCIoT)*, 1577–1581. https://doi.org/10.1109/ICGCIoT.2015.7380718

Sundmaeker, H., *et al*. (2016). Internet of Food and Farm 2020, in Digitising the Industry, 129–150.

Teare, M. D., Dimairo, M., Shephard, N., Hayman, A., Whitehead, A., & Walters, S. J. (2014). Sample size requirements to estimate key design parameters from external pilot randomised controlled trials: a simulation study. *Trials, 15*(1), 264.

Terano, R., Mohamed, Z., & Sharifuddin, J. (2017). Factors Affecting Urban Dwellers To Practice Urban Agriculture ., (July). https://doi.org/10.21474/IJAR01/4872

Terrell, S. R. (2012). Mixed-methods research methodologies. Qualitative report, *17*(1), 254–280.

Thomaier, S., Specht, K., Henckel, D., Dierich, A., & Siebert, R. (2014). Farming in and on urban buildings : Present practice and specific novelties of Zero-Acreage Farming (ZFarming), (July 2016). https://doi.org/10.1017/S1742170514000143

Trust, I. C. (2018). Improving IoT Technology Adoption through Improving Consumer Trust. https://doi.org/10.3390/technologies6030064

Tukiman, I. (2017). Roles of community towards urban farming activities, (May). https://doi.org/10.21837/pmjournal.v15.i6.243

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.

Walliman, N. (n.d.). "Research Methods: The Basics". Education, Health and Social Care, Social Sciences, 1-246.

Walter, A., Finger, R., Huber, R., & Buchmann, N. (2017). Opinion: Smart farming is key to developing sustainable agriculture. *Proceedings of the National Academy of Sciences, 114*(24), 6148–6150.

Weinberg, B. D., Milne, G. R., Andonova, Y. G., & Hajjat, F. M. (2015). Internet of Things:Convenience vs. privacy and secrecy. *Business Horizons, 58(6),* 615-624.

Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M. J. (2017). Big data in smart farming–a review. *Agricultural Systems, 153*, 69–80.

Yan, B., Yan, C., Ke, C., & Tan, X. (2016). Information sharing in supply chain of agricultural products based on the Internet of Things, *116*(7), 1397–1416. https://doi.org/10.1108/IMDS-12-2015-0512

Z. Ahmad and M. Pasha and A. Ahmad and A. Muhammad and S. Masud and M. Schappacher and A. Sikora. (n.d.). "Performance evaluation of IEEE 802.15.4-compliant smart water meters for automating large-scale waterways,." *In 9th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)*.