Automated Smoking Cessation Pattern Development through Information Retrieval

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ABSTRACT

Cessation of smoking is important to prevent non-communicable diseases and mortality. Smokers frequently approach doctors for various health ailments. This opportunity can be utilized to give smoking cessation advice. Therefore, this study aims to assist the physicians in identifying the smoking cessation pattern for their patients while giving motivational messages to smokers in order to help them quit smoking. The propose study is to design mobile applications which named as "jomQuit" that able to generate graph pattern on smoking cessation. Findings from our research states that motivational message and graph pattern of smoking cessation able to assist physician in monitoring patient and at the same time motivate patient to quit smoking.

Key words: Smoking cessation; pattern development; mobile technology; application design, information retrieval

1. INTRODUCTION

Concern about risks to public health has become major news in modern society today which involves issues like environmental risks, food safety or lifestyle risk such as alcohol consumption and tobacco smoking. According to [1], there are four major lifestyles that increase the risk factor of non-communicable diseases (NCDs) such as tobacco use, unhealthy diet, physical inactivity and harmful consumption of alcohol. Generally, non-communicable diseases (NCDs) is referring to chronic diseases like heart disease and stroke, diabetes, cancers and lung disease which typically last for long period of time and progress slowly [1, 2]. Moreover, strong evidence also shows that the excessive use of tobacco has become a major risks factor in four major groups of non-communicable diseases (NCDs) [1]. Therefore, today tobacco smoking issues has led to public health concern and various initiatives have been considered for prevention matters.

In Malaysia, cigarette smoking has become a bigger issue as it become the second main causes of death which verified by United Nations [3]. Besides, the World Health Organization (WHO) Commission on Macroeconomics and Health also stated that cigarette smoking is the primary cause of diseases and death in low income countries [3]. About 10,000 Malaysians lose their lives due to smoking habit in every year and may be increases from time to time

[4]. Therefore, various preventive measures should be taken at first place in order to help Malaysian people for quitting and aware on the effect of cigarette smoking.

Much effort has been taken seriously by Malaysia's Government in helping people aware on the effect of cigarette smoking [5, 6]. The effort is also focusing on encouraging them to quit smoking [5, 6]. Therefore, smoking cessation programs is one of the Malaysia's agenda in encouraging smokers to quit smoking. According to Datuk Seri Dr Hilmi Yahaya who is the Deputy Health Minister of Malaysia said that there are about 486 government clinics and hospitals have conducted smoking cessation programs for each year which generally attended by 10,000 smokers [7]. Another Malaysia's government initiative is by launching the anti-smoking campaign, Tak Nak (Say No) in 2014 [6]. The focus of anti-smoking campaign, Tak Nak (Say No) is to educate citizens on the hazardous of cigarettes via poster advertisements, billboards, magazines, newspapers, radio and television [5, 6, 8]. School-based anti-smoking program like exhibitions and talks also have been conducted to raise awareness about the dangers of smoking among students [6]. Unfortunately, the number of people that successfully quit on this unhealthy habit is still low due to addictive chemical nicotine in each cigarette that increase smoker's craving [7, 8].

Another key contribution of smoking cessation program is the role of physician and counsellor. According to Malaysian Association for Adolescent Health Vice President, Dr. N. Thiyagar, the role of counsellor or physician in dealing with smokers for smoking cessation seem to be one of the effective methods [9]. Most physicians or counsellor believes that it is their responsibility in helping, motivating, discussing, speaking, referring and monitoring their patients who are willingly to quit smoking [10, 11]. Since there is proven on the effectiveness of physicians or counsellor's role in smoking cessation programs, some guidelines may be needed to assist patients to quit smoking. Generally, physicians or counsellors will distribute questionnaire or having interview session prior smoking cessation counselling with all the patients in order to know their smoking status and willingness to quit. The information is gained to enable physicians and counsellors to assists and keep track on each of their patient's smoking cessation patterns. Therefore, this study aims to design mobile application that able to generate graph pattern on smoking cessation.

2. RELATED WORK

Study on smoking cessation in the health domain has been ongoing for several decades. It is proven by the emergence of health-based technology that assists people in monitoring their lifestyle. Generally, mobile phone has become one of the platforms for users to accomplish their daily tasks such as internet surfing, messaging, emailing and many more. Nowadays, there are many features among those mobile applications which have been developed with health technology and wearable sensors that potentially able to help people in making healthy lifestyle choices [12].

Mobile health technology or mHealth is defined as the use of wireless technology in mobile devices like mobile phone and tablet computer for delivering medical services and information to the user based on their needs [13]. According to [14], the field of mobile health technology or mHealth is increasing for the last ten years due to the emergence adoption of mobile phone. Even though, the use of mobile health technology is still at the beginning phase, it is proven helpful for users in accessing the medical information quickly [10, 12]. For example, user can quickly get medical information on blood glucose level, as the glucose meter is connected with user's mobile phone. Other than that, [15, 16] believed that the use of mobile health technologies or mHealth also effective in managing smoking cessation among hard smoker.

The adoption of smoking cessation features in mobile phones has been widely implemented as it is commonly used by physicians for monitoring their patient closely [16]. Moreover, it is proven that mobile phone-based smoking cessation have shown positive benefits for the smoker and physician [17, 18]. This is due to the characteristic of mobile phone that is small, light and easy to be used anywhere and anytime. However, an interactive content and design features of smoking cessation applications should be implemented to increase the chance of users to quit smoking [18, 19].

Studies shows that smoking cessation applications able to encourage and persuade people to quit smoking by providing useful and motivational message on the dangerous of cigarettes [17, 18, 20]. According to [20], encouragement and persuasion of user to quit smoking will increase with the help of mobile phone applications that is tailored to their situation and stage of quitting. Besides, encouragement message also will help users to stop the craving from smoking. Other than that, those smoking applications also designated with a feature of calculating the amount of money being waste for buying a pack of cigarette. Thus, users are able to keep track and reflect on their smoking habit with the help of daily messages reminder.

A study also found that smoking cessation applications with the use of abstinence rates features able to help persuade user in quitting smoking [21]. Abstinence rate of 28days which counted on each login is helpful in stopping smoking by some users [21]. The user's smoking history, socio demographics characteristics and first-time login were used in their study. Thus, it is proven that automated data collection of users using mobile phone applications has potential benefit in providing useful message to encourage smoking cessation.

In recent study, researchers found that there are 400 different kind of smoking cessation applications available on Google and Apple play store with estimation 780 000 times of users download it per month [22]. Therefore, the characteristics of smoking cessation applications like design features give a huge impact for users to choose and download it. Based on [23], they state that user's choices are most likely influence by the look, feel, social proof and title of the smoking cessation applications. Other than that, applications design features like provide motivation and tailored to personal preferences also enhance the choices of users to download and use it [23, 24, 25].

While, the adoption of smoking cessation feature in mobile phone is helpful in helping the smokers to quit smoking, the physicians still encountering problem of tracking smoking pattern [18]. Basically, the pattern on patient's smoking cessation status is gathered manually during face to face counselling session [26, 27]. Thus, patient may provide inaccurate information about their smoking status due to fear and lack of memory. Besides, some logistical aspects such as time, fees, parking and transportation are burdening for both patients and physicians [28]. Therefore, it becomes one of the failures of smoking cessation program. A study shows that, monitoring record on patient health is the most serious problem among physicians [18]. This is because the role of physicians in advising and motivating their patient in quitting smoking has been proven to be effective [9, 10, 11, 16]. Therefore, smoking cessation applications that is able to generate pattern of user's smoking status with additional motivational message is studied and analysed in this paper.

3. METHODOLOGY

This section describes the overall process done in this research. In overall the research were broken into two stages which are design phase and questionnaires and motivational messages development.

3.1 Design Phase

In design phase, the drawing and designing of smoking cessation mobile applications is shown and discussed. The smoking cessation mobile application in this research was named as "jomQuit" which is a combination from Malay word "jom" and English word "quit". Other than that, jomQuit mobile application also design in Malay language as the percentage of Malay smoker is higher than Chinese, Bumis and Indian smoker [29]. The design phase is divided into two blocks of process which are system architecture and interface design.

3.2 System Architecture

The system architecture is represented in context diagram as shown in Fig. 1 to describe the smoking cessation mobile application development process.
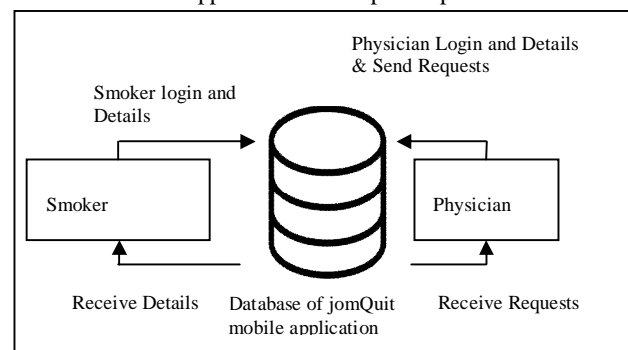

Figure 1: System Architecture

In overall, by referring o Fig.1, the steps involved in jomQuit mobile application are as follow:

1) Smoker accesses the jomQuit mobile application.

2) Smoker enters the information asked by the jomQuit mobile application.

3) Provided information is stored in database of the mobile application.

4) Motivated message will be responded to smokers based on the information given.

5) Individual graph of each smoker will be generated to be viewed and used by the physician

The information entered by the smokers that is stored in the database will be used by physician at the later stage to smoker's assessment.

3.3 Interface Design

An attractive interface design is designed to attract user to use this jomQuit mobile application. The process of interface design is simplified in Fig. 2.
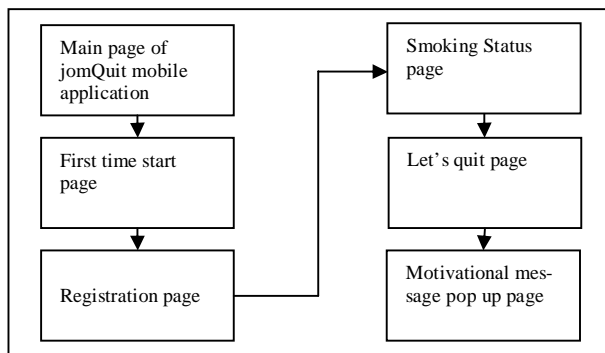

Figure 2: Simplified Process of Interface Design

The interface that was developed following Figure 2 is shown in Figure 3. In overall there are six main user interface has been developed which starts from welcoming until motivational message.

The jomQuit mobile application is designed to help physician generate pattern of each smokers in their quitting attempt of smoking with motivational messages to give users encouragement to quit and change their thinking. The detail design of the applications is analyzed and guided from several literature reviews [19]. In this research, individual smoking status either he or she is hard, light or transition smoker and willingness in quitting smoking are specifically gathered in order to generate their smoking cessation pattern. Besides, a few questionnaires also gathered to get the relation of it with their smoking pattern status

3.4 Questionnaires and Motivational Messages

The first part of jomQuit applications is to ask about participant's gender, age, education level and area live in. The second part is asking about participant's smoking status such as what kind of cigarette products do they use, frequency of their smoking on daily basis and how many cigarettes do they usually smoke per day. The third part is asking about type of smoker are they and do they have experience in quitting smoking before. The research also in-

terested in finding the eagerness of participants in quitting smoking habit. Last question is asking about participant's personal lifestyle problem which consists of 20 questions. The questions are generated from Positive and Negative Syndrome Scale (PANSS) Rating Criteria [30].

Figure 3: Interface Design

The assign ratings are based on scale of 1 to 3 which corresponds to incremental level of severity in quitting smoking. Ratings of 1 (absent) refer to the normal range. While, a rating of 2 (moderate) is indicating that the symptoms only occur occasionally or happen on daily life in moderate extent. The last scale is a rating of 3 (extreme) which refers to the most serious level and effected in major life functions. All the answered questionnaires will be stored in the database of jomQuit mobile application. The application was distributed to participants for seven weeks of this research. In the beginning, each participant always reminded to keep answering or use the application until seven weeks of research.

The example of questionnaire designated for jomQuit mobile application is shown in Table 1. This question is prompted for each time user use the jomQuit mobile appli-

cation in seven weeks. Besides, the questionnaire also prompted in Malay language.

Based on Table 1, the 20-questionnaire generated from Positive and Negative Syndrome Scale (PANSS) Rating Criteria are prompted to each of the participants and in the end, the result of their smoking cessation status either they are hard smoker, transition and light smoker will be displayed [30, 31]. The question is rated in three conditions either had absent symptoms, moderate symptoms and extreme symptoms.

Table 1: Questionnaires Setup

No.	Questionnaire Setup (In Malay language)
1	*Rasa tidak realistik atau bercanggah dengan apa yang diterima oleh umum sebagai realiti*
2	*Berlebihan mood yang boleh menyebabkan keletihan seperti terlalu gembira hingga penat*
3	*Berhalusinasi*
4	*Fikiran bercelaru*
5	*Mudah termenung*
6	*Rasa sedih, kecewa dan putus asa*
7	*Mudah hilang minat dengan keadaan sekeliling*
8	*Kurang rasa empati atau keterbukaan ketika dalam perbualan*
9	*Mudah hilang minat dalam interaksi sosial*
10	*Menghadapi kesukaran dalam menyelesaikan masalah atau tugas-tugas tertentu*
11	*Pemikiran yang anda mungkin mempunyai penyakit atau tubuh badan yang tidak dapat berfungsi dengan baik*
12	*Berasa panik, risau dan cemas tentang keadaan sekarang atau masa hadapan*
13	*Menyalahkan diri sendiri atau terbayang salah laku diri pada masa lalu*
14	*Rasa janggal dan kaku dengan ahli keluarga dan rakan sekerja*
15	*Bergerak atau bercakap terlalu perlahan yang menyebabkan orang lain menyedarinya*
16	*Rasa tidak percaya, mempertahankan diri, sikap keras kepala atau negatif terhadap keluarga atau rakan sekerja*
17	*Kurangnya kesedaran kepada orang-orang, tempat atau masa kerana kekeliruan*
18	*Kurangnya kesedaran dan kefahaman tentang keadaan mental dan kehidupan sendiri atau menafikan keperluan untuk masuk ke hospital bagi menerima rawatan*
19	*Kurang kawalan emosi sendiri sehingga tidak menyedari akan akibat atau kesannya nanti*
20	*Menolak untuk menyertai dalam sebarang aktiviti sosial bersama keluarga dan rakan sekerja atau bertutur dengan keluarga atau rakan sekerja*

Other than that, the participant's also get motivational messages correspond to the questionnaires. This is due to the previous research that shows push messages features in smoking cessation application are able to increase the opportunity for people quitting their smoking habit [23, 24, 25]. Therefore, the designated motivational messages for jomQuit mobile application are shown in Table 2.

Table 2: Motivational messages

No.	Motivational Messages Setup (In Malay language)
1	*Jom berhenti. Jangan biarkan asap rokok meragut nyawa anda dalam senyap.*
2	*Anda dapat mengelak daripada banyak penyakit yang tidak diingini dengan berhenti merokok.*
3	*Jika anda tidak berhenti merokok, anda berisiko mendapat penyakit dan kematian.*
4	*Kenapa tidak berhenti? Ayuh cuba, anda tidak akan rugi apa-apa jika berhenti merokok.*
5	*Oh tidak! Berhenti merokok sebelum menyesal. Jom berhenti.*

No.	Motivational Messages Setup (In Malay language)
6	*Tenangkan minda anda. Alihkan tumpuan anda dengan makan gula-gula getah yang tiada kandungan gula, jangan sesekali mencuba untuk hisap rokok.*
7	*Tarik nafas dan bertenang. Kuatkan semangat anda untuk berhenti merokok. Anda boleh!*
8	*Bagus! Inilah masa untuk anda terus berhenti dari tabiat merokok.*
9	*Jom berhenti merokok. Cuba untuk bergaul dengan orang lain agar anda dapat alihkan tumpuan daripada tabiat merokok.*
10	*Jom berhenti merokok. Jangan biarkan minda mengawal anda. Bertenang dan jangan jadikan alasan untuk merokok sebagai melepaskan tekanan.*
11	*Jom berhenti merokok. Tarik nafas dan minum banyak air mineral untuk kurangkan ketagihan meghisap rokok.*
12	*Jom berhenti merokok. Alihkan tumpuan anda terhadap rokok dengan melakukan aktiviti fizikal seperti bersenam.*
13	*Jom berhenti merokok. Bertenang. Kurangkan keinginan untuk merokok dengan makan bar coklat gelap.*
14	*Jom berhenti merokok. Alihkan tumpuan anda dengan membaca da mendengar lagu. Jom nerhenti merokok. Anda boleh.*
15	*Jom berhenti merokok. Makan makanan yang bekhasiat untuk mendapat tubuh badan yang sihat dan mengurangkan ketagihan terhadap rokok.*
16	*Jom berhenti merokok. Tenangkan fikiran anda dari merokok dengan pergi bercuti bersama keluarga atau rakan-rakan.*
17	*Jom berhenti merokok. Kurangkan tekanan anda dengan bersenam. Jangan sesekali melepaskan tekanan dengan merokok.*
18	*Jom berhenti merokok. Tetapkan fokus hidup anda dan beri hadiah untuk diri sendiri sebagai tanda anda berjaya berhenti merokok.*
19	*Jom berhenti merokok. Dapatkan sokongan dari orang-orang terdekat tentang rancangan anda untuk berhenti merokok.*
20	*Jom berhenti merokok. Simpan gambar-gambar yang dapat memotivasikan diri anda seperti potret keluarga.*

The motivational messages setup is designed in Malay languages and based on the previous reviewed paper about text messaging adoption in smoking cessation mobile application [32, 33]. The answered questions are stored in the database of the jomQuit mobile application.

4. RESULTS AND DISCUSSION

This section will discuss on the measures, analysis and result of the jomQuit mobile applications. This research are conducted in seven weeks that involving ten (10) participants. The primary outcome measure is the proportion of participants who most likely a heavy, light or transition smoker which will be generated into graph. At the start of the mobile application, participants are asked for their sociodemographic information, smoking status and view on quitting smoking. All the participants are compulsory to answer the question or use the mobile application until end of seven week.

The socio demographic information are age (15-20,21-25,26-30,31-35 or 36+), gender, education level (elementary, high school, bachelor's degree, master;s degree, profesional degree, doctorate or none) and living area (urban, suburban or rural). Other than that, smoking status of each participants and their willingness towards smoking cessation also gathered in this study. The variable measured are type of cigarettes product (manufactured, electronic, hand-rolled or others), frequency smoke per daily basis (daily, less than daily, not at all or not sure), cigarettes smoke per day (1-5,6-10, 11-15, 16-20 or 21+), smoker type (hard, transition or light), previous quit attempt

(yes or no) and smoking cessation consideration (yes, no or not sure). All the informations are gathered and stored.

A total of 10 participants are included in the analysis. In the sample of 10 participants, their sociodemographic information, initial smoking status, smoking cessation consideration and answers on questionnaire is gathered and analysed. From a total of 10 participants, 9 (90%) is a men and higher for smokers aged 21-25 (4, 40%), revealed that have bachelor's degree (5,50%) and live in urban area (7,70%). Other than that, the number of participants choose type of cigarettes product is higher for electronic cigarettes (4,40%), smokers who frequent smoke on daily basis (9,90%), smokers who are taking 11-15 cigarettes per day (4,40%) and declare themselves as hard smoker (6,60%). Study also shows that smokers who attempt to quit smoking (9,90%) but in state of consideration to stop smoking (6,60%).

Table 3 shows the smoking status and attitude of participants toward smoking cessation for 10 numbers of participants. Participants of this study are more likely to have average age between 21 to 25 years old, be male, living in urban area and have bachelor's degree. The participants involved also more likely to smoke 11 to 15 cigarettes on daily basis and prefer to smoke manufactured cigarettes. They had tried to quit before and more likely to intend smoking cessation.

Table 3: Characteristics of Participants for The Smoking Status and Attitude Towards Smoking Cessation

Characteristics	jomQuit users (N=10) % (n)
Gender	
Female	10 (1)
Male	90 (9)
Age, years	
15-20	10 (1)
21-25	40 (4)
26-30	20 (2)
31-35	10 (1)
36+	20 (2)
Education Level	
High School	10 (1)
Bachelor's degree	50 (5)
Master's degree	20 (2)
None	20 (2)
Living Area	
Urban	70 (7)
Suburban	10 (1)
Rural	20 (2)
Type of Cigarettes Product	
Manufactured	30 (3)
Electronic	40 (4)
Hand-rolled	20 (2)
Others	10 (1)
Frequency Smoke Per Daily Basis	
Daily	90 (9)
Not at all	10 (1)
Cigarettes Smoke Per Day	
1-5	10 (1)
11-15	40 (4)
16-20	30 (3)
21+	20 (2)
Smoker Type	
Hard Smoker	60 (6)
Transition Smoker	10 (1)
Light Smoker	30 (3)
Previous Quit Attempts	
Yes	10 (1)
No	90 (9)
Smoking Cessation Consideration	
Yes	60 (6)
No	10 (1)
Not Sure	30 (3)

As mention before, the study involves 10 participants which likely need to use and answer a given questionnaire throughout seven weeks. Participant's current smoking status is determined from the number of cigarettes they smoke per week and the questionnaire. From the study, we found that smoker 1, 9 and 10 is in phase of transition to fully quit smoking while the others found to be a light smoker. The participants smoking cessation results are recorded as shown in Table 4.

Table 4: The Participant Smoking Cessation Results

Participants	Number of Cigarettes							Current Smoking Status
	w1	w2	w3	w4	w5	w6	w7	
Smoker 1	5	3	6	3	1	1	1	Transition
Smoker 2	12	11	15	8	8	6	4	Light
Smoker 3	23	23	22	19	17	17	14	Light
Smoker 4	22	15	20	7	9	5	3	Light
Smoker 5	13	13	11	11	11	15	12	Light
Smoker 6	23	22	11	18	16	15	12	Light
Smoker 7	12	14	13	23	22	17	19	Light
Smoker 8	18	18	19	11	3	3	4	Light
Smoker 9	12	12	7	7	6	2	1	Transition
Smoker 10	4	2	5	9	8	4	2	Transition

Two individual participants, smoker 1 and 4 who are likey transition and light smoker respectively being discussed in this section. There are slightly many differences of the graph pattern between smoker 1 and smoker 4. Based on Table 5, both smoker 1 and 4 are male and living in urban area. Besides, smoker 1 is in range of age age 31 to 35 years old and had master'sdegree while, smoker 4 in range of age 26 to 30 years old and had bachelor's degree. Smoker 1 is classified as a transition smoker based on the number of cigarettes he smoke per week and the answered questionnaire, while smoker 4 is grouped under light smoker.

In the first week of this study conducted, the number of cigarettes smoke for smoker 1 is slightly lower with 5 cigarettes than smoker 4, with 22 cigarettes per week. The number of cigarettes smoke by smoker 1 continue to decrease until the last week of study conducted with only 1 cigarette. However, smoker 4 also start to reduce his amount of cigarettes starting from last second week, with only 5 cigarettes. Besides, study also found that smoker 1 likely interested in quitting smoking and have experience on trying to quit it which is shown in Table 7. Thus, smoker 1 can be said that he in phase of transition or trying to quit smoking. However, smoker 4 have zero experience in quitting smoking before but intersted in quitting smoking . Therefore, smoker 4 cannot be declared as transitional smoker as he likely in the first step to quit smoking which can be shown on his unstructured amount of cigarettes per week. Other than that, both participants also have different smoking style whereby smoker 1 choose others type of cigarettes to smoke and significantly not smoking for everyday in a week while smoker 4 choose manufactured cigarettes and smoke almost everyday. This can be shown

in Table 6 which is about the smoking status of the smoker 1 and smoker 4.

As a conclusion, smoker 1 can be describe as a transitional smoker due to consistent control the amount number of cigarettes per week, while smoker 4 is declared as light smoker as he begin to quit smoking slowly and nearing to stop smoking. Therefore, the weekly smoking graph pattern of each individual smoker 1 and 4 is shown in Fig. 4 and Fig. 5. The physicians or counsellors are able to access and keep track on their patients quitting status at anytime. Moreover, it also will reduce the time taken for physician and counsellors in gathering patient's data before the real counselling session begin.

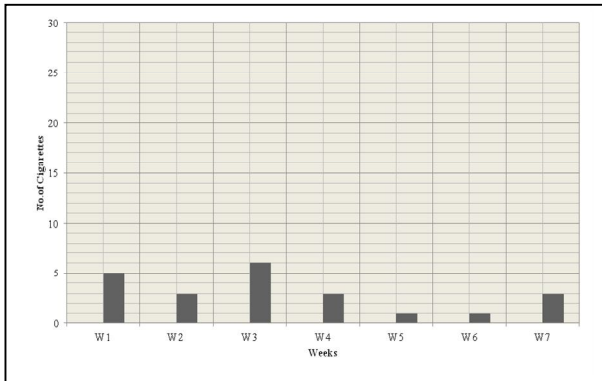The graph of smoking pattern for both smokers is shown in Fig. 4 and Fig. 5.

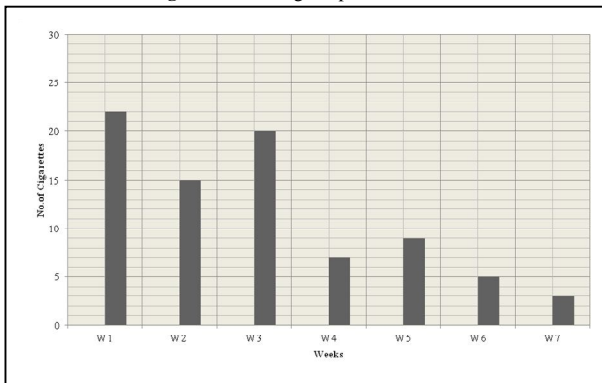**Figure 4**: Smoking Graph Pattern of Smoker 1

Figure 5: Smoking Graph Pattern of Smoker 4

Table 5 shows list of socio-demographics information for smoker 1 and 4. Table 6 shows smoking status for smoker 1 and 4. Table 7 shows the smoker's 1 and 4 attitude towards smoking cessation.

Table 5: Socio demographics information for smoker 1 and 4

Socio Demographics Information	Smoker 1	Smoker 4
Age	31-35 years	26-30 years
Gender	Male	Male
Education Level	Master's degree	Bachelor's degree
Living Area	Urban	Urban

Table 6: Smoking status of smoker 1 and smoker 4

Questions on Smoking Status (In Malay language)	Smoker 1	Smoker 4
Apakah jenis produk rokok yang anda gunakan?	Lain-lain	Rokok buatan
Berapa kerapkah anda merokok?	Setiap hari	Setiap hari
Berapa batang rokok yang anda guna untuk 1 hari? (1 kotak = 20 batang)	1-5 batang	21-lebih batang

Table 7: Participants attitude towards smoking cessation for smoker 1 and smoker 4.

Questions on Smoking Cessation (In Malay language)	Smoker 1	Smoker 4
Anda adalah perokok?	Perokok peralihan	Perokok tegar
Adakah anda pernah mencuba untuk berhenti merokok?	Ya	Tidak
Adakah anda serius untuk berhenti merokok sekarang?	Ya	Ya

5. CONCLUSION

In conclusion, this paper is studied on smoking cessation pattern for each of individual smokers. The design of smoking cessation applications is explored to help people quit smoking habit or change their thinking about smoking. The study shows that smoking cessation pattern and motivational messages prompted to the smokers able to increase their desire in quitting smoking.

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