JomIoT Prescription For Life

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***Abstract*—Non obedience to medication symbolizes a misconception of abuse and for-getting of medication, it is a major problem globally and it is a result of high morbidity and mortality. Furthermore, an increase in unnecessary attendance to emergency department and the clinics which could result in a huge waste in our health resources. This paper brings forward an intellectual medicinal reminder device of two parts, a mobile functional application that is connected wirelessly to the hardware part that is a special medicine box in a form of a smartphone cover case or external accessory incorporated with IoT. Device evaluation study was conducted by distributing survey questionnaires to different target population audiences. This reminder device is outstanding concerning its perfection and convenient method to eliminate medication nonadherence, thus encouraging fast recovery without obstacles and is anticipated to save financial resources. Direct managerial and action-wise implications are discussed throughout the paper.**

***Index Terms*—Internet of Things; Medication Adherence; Smartphone Accessory; Wireless Connectivity.**

I. MEDICATION ADHERENCE AND MEDICATION REMINDER DEVICE

Medical prescriptions are instructed to be consumed on time, however, it has been known that as high as 50% of the world population forgets to take the prescribed medicine at least once a month [1]. Neglecting or forgetting the timely consume of cure pills is a main cause of reported non-adherence, it would eventually result in negative impact on the recovery or can be fatal particularly for incurable illness patients with life-threatening symptoms such as unstable hypertension, lipid disorder or diabetes. Thus, forgetting prescribed pills has increase the chance of heart attacks, renal failure, or other deadly diseases which by default would lead to disability, illness, or deaths [2, 4]. Furthermore, ignorance to taking antibiotics in a timely manner results in a drop in cure rates and could escalate the likelihood of creating new pathogenic bacteria [5, 6], where visits to the emergency department can be avoided frequently. Abusing or forgetting drugs has an impact on financial in terms of health and resources. Globally, an average of 290 billion dollars is wasted yearly on curing patients due to medication adherence errors [7]. For our research, a intelligent medicine reminder application is suggested to optimize appropriate medication adherence for all age requirements which positively affects the health section and its recourses. To advance in developing effective reminder method, an IoT connectivity is used to link the re-minder application with the unique casing [8, 10, 11], to control the container from the application remotely with simply one click. The application will include an advanced database of information regarding countless medications including the necessary schedule and dosage to be consumed by users at each time, besides having outstanding performance in regulating users nutritional needs by indicating data of whether the pills are to be taken between meals or the required water portion the patient needs with each medication intake.

The role of this proposal is to enhance and create an intellectual health system by advancing towards a sickness-free and healthy environment with increased adherence to medication that significantly boosts health and well-being as it is portrayed to be suitable for assisting people from different ages and personals to consume medication on time and avoid complications without the supervision of a medical external party. Table 1 indicates the examined hypotheses, recognized from the proposed reminder application, as configured below.

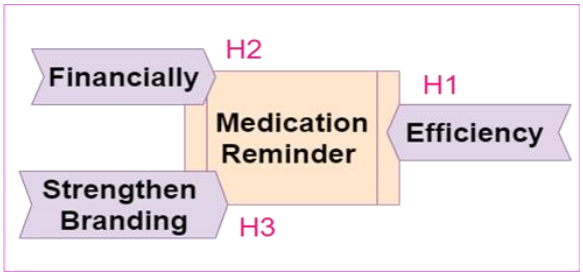

Figure 1: Research hypothesis design

Table 1
Research Hypothesis Plan

No.	Research Hypothesis
RH1	Affects economizing cost and resources for the medical section.
RH2	Ensure significance on medication adherence.
RH3	Establish reliance between the users and device.

As shown in Table 1 three hypotheses are represented related to value, efficiency, and branding, which are needed to acquire from the proposal.

- RH1: Creating intelligent mechanism of medical reminder would highly contribute to saving wasted efforts and cost supply for the health and clinical fields which dramatically improve overall general health.
- RH2: The designed medical box should take the size and shape of a chain accessory or a smartphone cover case rather than all the common pillbox available to confirm that the users would never under any circumstances neglect to carry the special case which

accordingly will crucially raise the medication compliance.

- RH3: Establishing notable brand strength between user and product by signifying security, whenever users click 'Take the Medicine', the medicine container will not be opened only after confirming the user identity as the patient will be a coded upon registering in the application or the app could request biometric verification depending on the phone version and the patient preference.

The proposed smart reminder device remarkably enhances user's health. Besides allowing a modern unique experience and convenience which directly increases the medication compliance level, assuring a better treatment plan, and saving lives by avoiding cardiac episodes. The novelty here is the utilization of IoT to provide wire-less connection within two separate and contrary parts which are the software application and the opposite part as hardware being manifested as smartphone case, to achieve positive levels of medication adherence.

II. LITERATURE REVIEW

Numerous research attempts were carried out to resolve or balance the disastrous issue of medication compliance developing a medication alarm-based remainder application. There are a variety of similar applications in the IT health field, the most popular are MyMedSchedule, RxmindMe, and MyMeds [12], yet the issue has not been solved yet and a huge concerning the percentage of people who still does not take medication as scheduled and indirectly abuse medication use by never sticking to the exact dosage [13]. Table 2 below illustrates a detailed comprehensive study based on the recent techniques and approaches devoted to enhancing medication compliance followed by the limitations found in each technology.

Figure 2: An example of the non-smart medication case

Table 2
Related Work-Study

Topic	Reminder Approach	Limitations
"Comprehensive Approach for A Smart Medication Dispenser" [14].	The Smart Medication Dispenser (SMD) is connected to an application through Bluetooth, to improve medication adherence.	• Dispenser size limits having remote features. • The developed prototype is prone to damages created in long-term usage.
"Medication remainder and healthcare _ an android application" [15].	Emphasize connecting doctors with patients using a mobile android application, operates using an alarm sound, and notification messages.	• Limited to one type of user persona, which are patients under medical staff's observation. • Does not feature online video consultation with doctors.
"A Smart Pill Box to Remind of Consumption using IoT" [16].	Consists of a pillbox and a synchronized clock that works by messages or email notification.	• The complex and undesirable approach of manually writing the dosage taken following each notification reminder.
"Smart drugs: Improving healthcare using Smart Pill Box for Medicine Reminder and Monitoring System" [17].	The specially designed 9 units pillbox is wirelessly connected to a mobile application.	• The outdated method requires a manual complicated procedure for inserting pills and operating the system.
"Smart pill dispenser using the Internet of Things" [18].	The GSM is used to notify users to consume medication. The smart pillbox works using ultrasound sensors.	• Extremely limited database information requires users to manually fill up medicine-related data on their own.
"Mobile Apps for Increasing Treatment Adherence: Systematic Review" [19].	In this paper, an analytical study was carried out to examine the diverse technologies and mechanisms of multiple reminder methods.	• Lack of the examined case study data results in the unprecise evaluation. • Did not accurately fix the medication adherence issue.
"A medication reminder mobile app: does it work for different age range" [20].	An Android application that is designed specifically to provide support with medication control therapy for all age groups.	• No real live scenario evaluation consequence inaccurate and generalized results, which accumulates to a non-realistic reminder method.
"Medicine Reminder and Monitoring System for Secure Health Using IoT" [21].	The study highlights the analysis of medication and monitoring techniques. The reminder is connected through internet technology to a view screen.	• The unnecessary use of a ridiculously large-sized screen for monitoring feature instead of using simpler methods as the mobile phone screen.
"IoT based Advanced Medicine Dispenser Integrated with an Interactive Web Application" [22].	Pill dispenser is featured with advanced technologies of IoT, machine learning, and cloud computing to increase and improve medication adherence.	• A few limitations are derived from the conducted evaluation test in the paper. • A concerning number of users testified to have forgotten the medication dispenser when going out or travelling.

Topic	Reminder Approach	Limitations
"Demo Abstract: Mobile Sensing to Improve Medication Adherence" [23].	Use activity learning (AL) application to analyze human activities for better reminding techniques.	• Incapable of storing liquid medications. • Convenience limitations due to the absence of remote features, thus creating more issues related to medication adherence.

III. METHODOLOGY

Through this study paper, an intellectual medication container is advanced which includes a mobile reminder application, the novel architecture of this innovative device is shown as a prototype in Figure 2. The medical container takes the fit form of the smartphone protection case or external accessory, which provides a convenient exceptional experience of remote features to accompany the user. The application is wirelessly connected utilizing the "Internet of Things (IoT)" to the special medic container.

The developed notice technique were examined by conducting data collection operation and analysis method. As shown in Figure 3, the data gathering process is organized on the web using the mixed-mode assessment for both qualitative and quantitative research to carry precise results for this paper and to provide a in-depth analysis of the effectiveness level of the research [24-28]. The analysis is split into an interview and survey form [29-35] published through an appealing user experience interface to enable human subjects to evaluate with convenience and entertaining process. Larger audiences diverse from different age gab will be covered in the study to get a precise and reliable result based on different opinions.

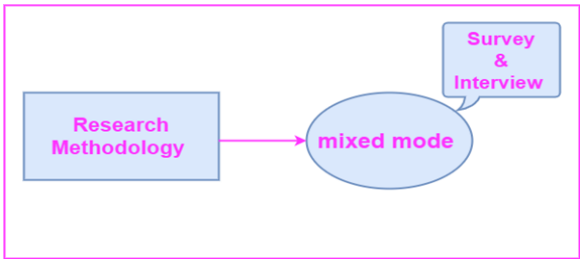

Figure 3: Research model

The sampling approach indicates the zone of population or respondednt that is possibly simple to seek accessibility for the benefits of the research [36-43]. The respondent audience was categoried based on different age groups (18-85 years old) as the focus was directed into financially responsible individuals to generate faultless results in respect of the economic cost factor, as an assumption is made that acknowledged people below 18 and above 85 financially dependent. For example, individuals younger than 18 years of age might not possess the economic understanding to add up to the study, as the proposed reminder will highly impact the financial means. The interview with the survey will need to be distrusted evenly into the sample population yet, to create a raise in the accuracy rate of results the equality in distributing the evaluation. The evaluation questionnaire will be collected from educational academies, public medical centres, and markets. To organize a detailed evaluation, two places (UNIVERSITY MALAYA, and UCSI UNIVERSITY) were chosen as of an educational institution based on multiple factors and different aspects of students as the UNIVERSITY OF MALAYA is a governmental institution thus, the students would have completely different principles and values compared to UCSI UNIVERSITY students as it is considered a private sector. On the other hand, the data distribution for the health centres would occur in Columbia Asia hospital which is a private global hospital with a completely different environment compared to the second-place University of Malaya public centre.

IV. RESULTS AND DISCUSSION

Both university and hospital participants acknowledged that the cost was the major issue faced during hospital visits as it was considered a high amount to be paid. Furthermore large number of the obtained responses highly supports and encourages advancing the reminder, however, the results have shown a clear difference between both environments as the hospital patients percentage was higher than the students in regards to financial consideration as presented in Figure 5.

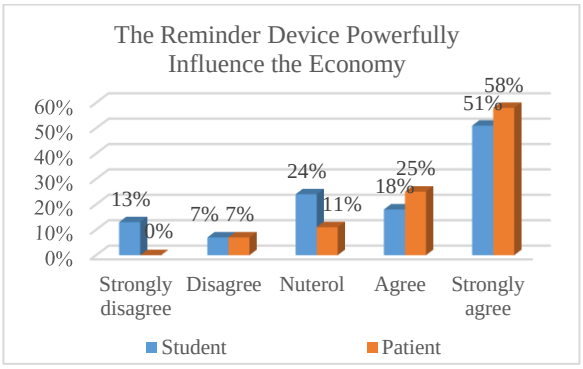

Figure 4: Impact of cost

Effectiveness in this study mainly indicates the special feature of being remotely available which was compared in the point of view from both sides. 90% of the participants positively responded with an amusing agreement to the innovative device remote feature. Besides, the patients reacted with higher enthusiasm and encouragement compared to the students regarding the dire demand for innovation as shown in Figure 6. In respect to the trust grows between the user and the proposed item, it was revealed that an average of 97% of participants showed acceptance in terms of considering secure measurement as a brand trustworthy factor to the health product. Figure 5 shows the positivity and acceptance of reviewing the security code measurement or finger recognition method to secure medications in the container from unauthorized and forbidden access.

About 70% of responses collected from the University of Malaya and UCSI UNIVERSITY from average income individuals indicated exceeding the RM 200 amount during their hospital visits which were considered highly expensive amounts for their dedicated budget which they struggle to pay despite the income. Regardless of that, the remaining 30% showed no remorse or agreement regarding the costly payment of clinics due to an unrealistic reason of stating they do not have any illness to require going to clinics often which was disregarded as a reasonable stamen for the study. On the other hand, compared to the 70% a total of 94% responses

from the medical centre has emphasized the dire need to publicize the proposed application as patients have been struggling emotionally and financially from the medication and visitation fees specifically the payments made during the unnecessary visitation that could be avoided by using the proposed system.

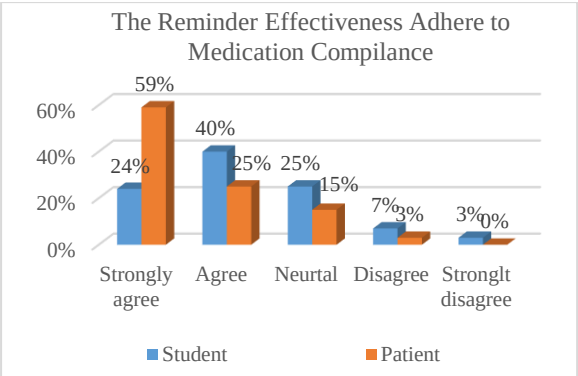

Figure 5: Effectiveness feature of the device

Through deep analysis, interview questioner showed a high percentage of almost 95% based on both categories target explicitly encourages implementing the finger-print security measurement to protect the user and prevent any hazardous situation especially around kids as it has been revealed that child medicine poisonous is a major issue not locally simply a universal issue with multiple evident research techniques to build a secure medical container, thus implementing the security measurement would prevent unauthorized accessibility [44, 45]. This is also reflected by Figure 6 by the high "Strongly Agreed and Agreed" statistic.

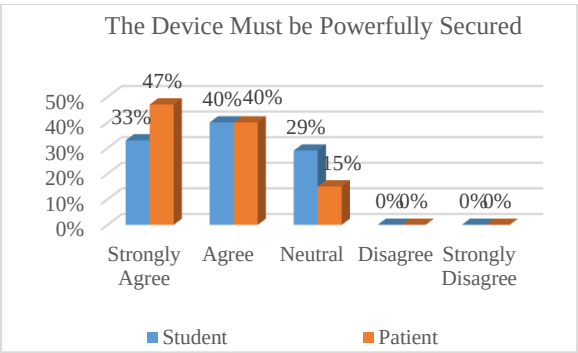

Figure 6: Security factors of the health device

V. Conclusion, Shortcomings and Future Enhancements

In this article, a proposal of an intellectual reminder device is put forward to perfectly and completely solve the vital problem of medication non-adherence level, that can be catastrophic. Therefore, an intellectual smart device was developed as a special medical container, formed as smartphone cover or chain accessory in shape, size, and design. Besides including the effective remote solution features that could be carried out and controlled easily by connecting them to the applications via IoT technique, adherence to medications can also be improved and in turn improve the health and fitness potential of users' lives. Moreover, its contributes greatly in saving lives and has the potential to advance into a major health equipment which would eventually without a doubt create a sustainable wealthy economy by reducing the amount wasted in the presence of unnecessary clinical attendance that prevent financial failure. In addition to the above features, the device includes a secure environment by applying a fingerprint recognition system to avert child medical poisonous and control medicine abuse for certain individuals.

The proposed device could motivate its users to consume the medicine while being positively driven to maintain a healthy lifestyle and fast recovery by considering important factors in terms of cost as summarized from the questionnaire study. However, to achieve the outcomes needed, to become a healthier nation for all individuals, the research study would require specific research resources to publish the significance of development for each human object, and the improvement is shown. Future configurations to enhance the study is defined by developing a physical prototype with the additional feature of telecommunication consultation between the users and medical staff.

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