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The Design and Development of a Prayer Counter

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Abstract. This paper presents the systematic design process and prototype development of a prayer counter. The prayer counter is used to count the number of units of prayers or raka'at, based on the number of prostrations. The unit of prayer is determined by the accumulated number of prostration, which are two prostrations for one unit of prayer. The prayer counter receives an input signal from the input unit as it is actuated by an individual in prayer. The actuation of an input unit begins as an individual's head touches the input unit in prostration. The input signal will be converted into an output signal and displayed with a Light Emitting Diode (LED). Users of the prayer counter can see the current unit of prayer through the display unit indicator. The LED's lights indicate the current number of prostrations and indirectly indicate the current unit of prayer. This project aims to offer a technological advantage, to ensure that uncertainty of the number of prayer units is avoided. This study uses the Design Thinking Process model as a methodology for creating 'sejadah pintar'. The result of product testing, and initial evaluation of the product, shows that the prayer counter can display the number of prostrations and units of prayer precisely. It is therefore able to avoid doubt in the number of prayer units, if the individual gets distracted in prayer. In addition, the responses received from potential users, about the benefit of the product to them, was very positive. In conclusion, considering the relevant issues of the product being designed is the most important step of the design process.

Keywords: Prayer, unit of prayer, prostration, prayer counter

INTRODUCTION

'Solat' is the practice of formal prayer in Islam. It is important for Muslims, as it is one of the five pillars of Islam. 'Solat' has prescribed conditions, a prescribed procedure, and prescribed times. Performing prayer five times a day is obligatory to fulfil these conditions i.e., Islam, not mad, etc. In order to perform a valid prayer, Muslims must perform according to the prescribed conditions, procedures, and times. In an ideal situation, prayer in Islam consists of a repetition of two or more units of a prescribed sequence of actions and words, otherwise known as a 'raka'at'. The number of obligatory units for each prayer varies according to the time; for instance, the number of compulsory units for dawn prayer is two, whereas four units are compulsory for the afternoon prayer. Therefore, performing prayer with the wrong number of units leads to an invalid prayer, unless forgotten. Even though forgetfulness in prayer is not a sin, it is not a good enough excuse for making a mistake in prayer. In current practices, counting the units of prayer is carried out by the individual. The counting process is normally carried out in the form of finger counting (physical) or verbal counting (mental). Both of these forms of counting rely on human memory. However, the memory of an individual is subject to internal and external disturbances that can lead to doubts in the number of prayer units. Even though Islam offers a way to compensate for doubts in the number of prayer units, this project aims to offer a technological advantage, to ensure that uncertainty of the number of prayer units is avoided.

Several products have been devised to assists individuals to count their units of prayer. Kasman & Moshnyaga (2017) presents new technique for sensing Muslim praying postures and counting posture cycles by a smart mat. Unlike related methods, the proposed technique detects human postures in a sequence based on voltage patterns generated by mat sensors. Experiments show that it provides unobtrusive and robust detection of all six raka'at postures (Fig. 1), and reliable raka'at counting. Its prototype implementation is inexpensive, easy to use and quite helpful for users. Malek et al. (2021) employed Design Thinking Process model as methodology to create 'sejadah pintar'. The push plate switch is used as a signal probe for the prostration movement and the segment display is used to display the number of raka'at in the prayer. The Arduino Wemos D1 Micro controller is used to control the entire circuit. Nana Sujana et al. (2022) Used of ultrasonic sensors as input sensor to count prayer cycles based on Arduino Uno. The raka'at counter will count when the worshipper does prostration. Decy Nataliana et al. (2022) devised a raka'at counter to reduce mistakes in calculating the number of raka'at during prayer. The piezoelectric is used as sensor which is placed on the top of the prayer mat. Raka'at is calculated when piezoelectric has detected twice prostration. There is an LED indicator when the raka'at is done which should be in accordance with the prayer time using Real time clock module (RTC).

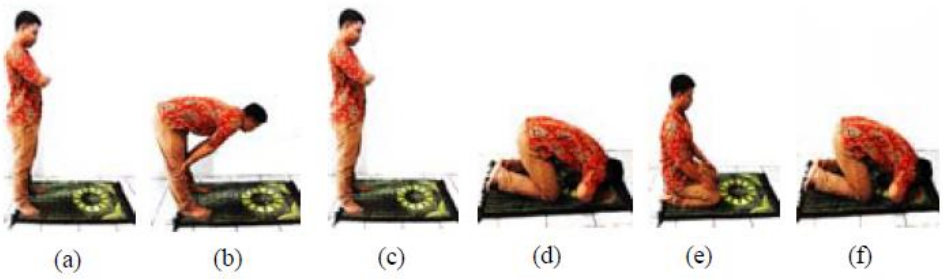

Fig.1. The sequence of postures to complete a single Rakah in a prayer: (a, c) standing (b) bowing, (d,f) prostration, (e) sitting (Kasman & Moshnyaga, 2017)

The objective of this project is to design, fabricate, test, and evaluate, a prayer counter device that can assist individuals to count their prayer units. The main concern of this project is to consider all of the relevant issues of the product. These issues are essential, in order to meet the objectives of this project, which is to produce a beneficial product for users. The objectives of this project are two-fold: 1) to identify issues in the design and development of a prayer counter, and 2) to fabricate, test, and evaluate, the usability of the product with its potential users.

METHODOLOGY

The design procedure for a prayer counter is illustrated in Fig. 2. Using the technique of brainstorming, design considerations for a prayer counter were initially outlined as part of the problem definition. Four significant issues, including interface issues, functional issues, ergonomic issues, and lifecycle issues, have been identified. This ultimately leads to the identification of needs. A concept design was developed based on the requirements that were identified. The technique of brainstorming was employed, and the design was subsequently refined through iteration. Creation of a prototype, testing of the product's functionality, and evaluation of the product were carried out. The evaluation of the product was conducted using an interview survey.

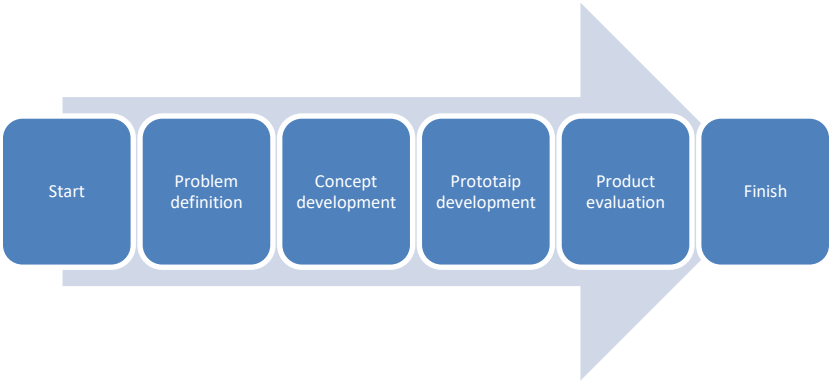

Fig. 2: Design process of prayer counter design

Design issues are the considerations that design engineers must head whilst designing a product. Based on empirical study, (Ahmed & Wallace, 2003) derived four major issues that design engineers consider in designing a particular part. These are namely 1) issues related to interface/environment, 2) issues related to the function of the product, 3) issues related to lifecycle, and 4) issues related to the product's characteristics. Issues to be considered by design engineers in developing a product, have been proposed by several authors of Engineering Design books, such as Pugh's checklist (Pugh, 1997), Technical Product Properties (Hubka & Eder, 1988), and Pahl and Beitz's checklist (Pahl & Beitz, 1996). They suggested that all of these issues should be considered and translated into a requirement list. Furthermore, these issues can be used during the latter phase of the design process, for design evaluation.

In the design of a natural convection solar drying system, Akoy et al., (2006) considered the following issues; 1) the amount of moisture to be removed from a given quantity of wet mango, 2) the harvesting period, during which the drying is needed, 3) the daily sunshine hours for the selection of total drying time, 4) the quantity of air needed for drying, 5) daily solar radiation to determine the energy received by the dryer per day, and 6) wind speed for the calculation of the air vent's dimensions. Sudin &Ahmed (2009) found that the interface between the sub-assemblies of a product often changes during the development phase of a product's lifecycle. In addition, they concluded that considering the issue of interface between components or sub-assemblies is important during the early phases of the product's development; especially for complex products (where the product has many components).

RESULTS AND DISCUSSION

Issues considered and requirement identification

This section describes the issues considered in the development of a Portable e-Prayer Counter. The four issues considered were classified as 1) the interface issue, 2) the functional issue, 3) the ergonomic issue, and 4) the lifecycle issue. Fig. 3 shows the initiation of the issues considered in the design of a prayer counter. These issues are important, in order to develop a preliminary design of the product. A detailed description of how these issues were considered is given in the following section.

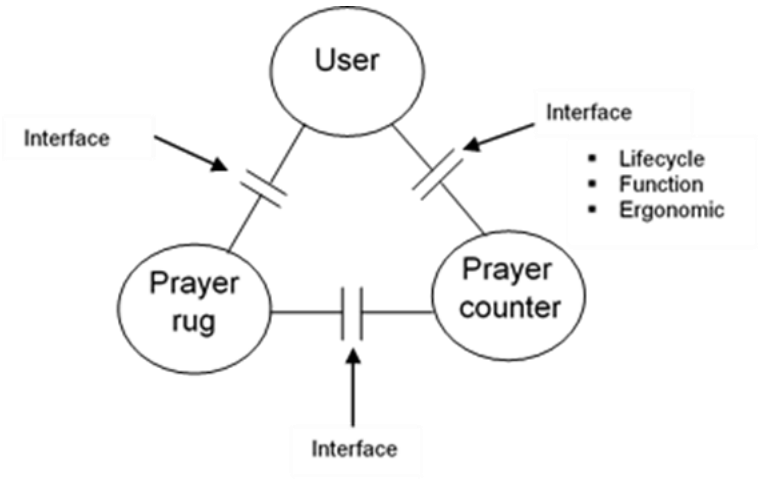

Fig. 3 Issues in the design and development of a prayer counter

The Merriam-Webster dictionary defines 'interface' as the place at which independent and often unrelated systems meet and act on or communicate with each other. In the design of a prayer counting device, two types of interfaces were considered, namely; 1) user-product/component interface, and 2) component-component interface. In this context, user-product/component interface determines the method and place of interaction between the device and the user; whereas component-component interface determines the joining method between the prayer counter and the prayer rug.

Interface between the prayer counter and the prayer rug

The imposed constraint (designer's constraint) on the design of a prayer counting device is to use prayer rugs that are available on the market. Therefore, the modification of existing prayer rugs needs to be carried out. The issue is how to attach the prayer counting device to the prayer rug. The consideration is to either join the device to the prayer rug permanently or non-permanently. A use scenario was adapted to understand how the user is going to use the product during its lifecycle phase. For instance, the user may want to wash the prayer rug manually or using a washing machine. The washing action and detergent may harm the electronic parts of the counting device, if the join is permanent. If the prayer counting device is permanently joined to the prayer rug, then the user needs to buy the counter and the prayer rug together. With a non-permanent join, the counting device can be disassembled from the prayer rug for washing. In addition, the user can buy the counting device as a separate unit, without needing to buy a prayer rug. In this situation, the advantage is to the user, as they will have an option to either buy the counter separately, or to buy the product as a package (counter with a prayer rug). Despite this advantage, damage of the electronic parts from washing can be avoided, due to the non-permanent join.

Interface between the user and counting device

The second interface issue consideration was to determine the part of the human body that would be used to activate the input switch of the counting device. Considering the actions of prostration during prayer, four human body parts are considered possible to activate the input switch of the counting device, namely palms, forehead, and knees. The feasibility to use these parts was studied in respect to size, height, weight, and gender of an individual. Repeatability is the main issue of concern in the design of a prayer counter. The observation was carried out at the Al-Azim mosque in Ayer Keroh Melaka, to study the repeatability of these three body parts (i.e., forehead, knees, and palms) to the prayer rugs during prayer. In this context, repeatability is defined as the consistency of the human body to touch the same place during prostration. As a result, the forehead was identified as the most promising means of activating the input switch of the prayer counting device, due to its high repeatability feature.

Interface between the user and the display unit of the prayer counting device

The third issue considered was the interface between the user and the display unit of the prayer counting device. The input from the user will be displayed to indicate the units of prayer at any particular time. The distance between the user's eyes in the prostration area on the prayer rug, was determined as the longest distance. Therefore, the indicator on the display unit must be seen clearly from this distance. However, this consideration was subject to ideal situations; in which the user does not have any disability to recognize colour i.e., colour blindness.

Function issue

Function is what the product has to do, or is able to do. The prayer counting device is developed to assist individuals to count units of prayer. Therefore, the prayer counting device is aimed at freeing an individual from having to purposefully count the units of prayer. This is the action performed by an individual to obtain the desired output e.g., press a switch to turn on a light. Therefore, the actions performed during prayer were studied to determine an appropriate way of how the prayer counting device should act, in order to count the units of prayer. Two feasible actions of an individual during prayer were considered to determine the unit of prayer. They were 1) the number of bows and 2) the number of prostrations. Both of these actions are required to be done twice to complete one unit of prayer. Both of these actions seem to be promising.

Bowing is the action in which the palms are placed on the knees, with fingers spread, but without touching the prayer rug. Prostration is the action in which several parts of the body i.e., palms, knees, and forehead, touch the prayer rug. To devise a device that counts the units of prayer based on the number of bows, could be more complicated and expensive, since the bowing action can only be sensed from a distance; but for the prostration action, the device could be simpler as direct contact

between an individual and the input switch of the prayer counting device can be accomplished easily. A decision was made to use the number of prostrations to determine the units of prayer.

Ergonomic issue

The ergonomic issue is important to determine the characteristics of a product, including size, shape, and weight. In the design of this device, ergonomics was considered, in order to give users a comfortable condition whilst using the product. The issue is how to ensure that the user feels comfortable to carry the product everywhere they go i.e., held in the palm of the hand or kept in a pocket (for a man) or handbag (for a woman). No intricate shape or sharp edges for the product's casing were decided.

Lifecycle issue

The number of parts would be kept to a minimum. The thickness of the product casing would be as even as possible. All of these characteristics were determined in consideration of manufacturing and assembling the Portable e-Prayer Counter.

DESIGN AND COMPOENENT OF THE PRAYER COUNTER

This section will discuss the components used to build the prayer counter, based on the considerations explained in the previous section.

Input unit

Input unit is the element used to provide a signal to the prayer counter. In the design of the prayer counter, a push-button switch, with a normally opened position, was selected as the input unit. This push-button was selected as it can fulfil the intended function of the input unit for this product. The switch operates when the push-button is pressed and cuts off the electrical current once the push-button is released. This is a `simple on-off switch with two terminals that are either connected or disconnected from each other.

Energy source

The energy source for the digital circuitry of the prayer counting device is a 6V DC power supply from a lithium battery. This power source was selected as it is light in weight and small in size.

Light source unit and resistance calculation

LED was selected as an indication source. Eight red LEDs, with a voltage drop of 2V, were used in the development of the prayer counter. Eight LEDs are required, as the maximum number of prostrations in a complete cycle of prayer is eight; which is equal to four units of prayer. For instance, the eight prostrations that are required for afternoon prayer, is equal to four units of prayer.

The eight LEDs were arranged in parallel and emit light in sequence, once the push-button is

pressed. Only one LED will be lit at a time. To limit the current flow through the LED, a resistor was connected in series to protect the LED from damage. Since the current will flow to only one LED at a time, only one resistor was connected in series to the eight LEDs. The value of resistance for the resistor was calculated based on Equation (1). The resistor value, R is given by:

$$R= (V_S-V_L)/I \text{ ……... (1)}$$

V_S = supply voltage

V_L = LED voltage

I = LED current

To ensure the safety of the LED, the current chosen for the LED was less than the calculated current. The calculated current value was then compared to the nearest standard resistor value. The nearest and greatest value of resistance was chosen, so that the current produced would be slightly less than the chosen LED current. It may be possible to choose a far greater resistance of resistor, in order to reduce the current for a specific purpose, such as to increase battery life, but this will make the LED less bright. In this device, a 1kΩ resistor was used for LED protection.

IC counter

The 4017 takes a clock pulse in, and then steps the output from negative to positive in a series of ten steps; with only one pin being ON at a time. It has the unique capability of counting up to a certain number and then restarting the count, counting up to a certain number and stopping. It can also be cascaded to more 4017's for a higher count. The outputs are labelled 0 to 9. It is operated by a 6V DC power supply. Since only 8 outputs are required, only one IC4017 was used to build the prayer counting device, as only one output needed to be on at a time, in order to fulfil the desired function.

FINAL DESIGN AND PROTOTYPE DEVELOPMENT

The design and simulation of the electronic circuit for the prayer counter was carried using Proteus 7 professional software. Once the simulation showed that the circuit worked, fabrication of the circuit onto the circuit board was carried out. Fig. 4 shows the layout of the electronic counter circuit and Fig. 5 shows the prototype of the prayer counter.

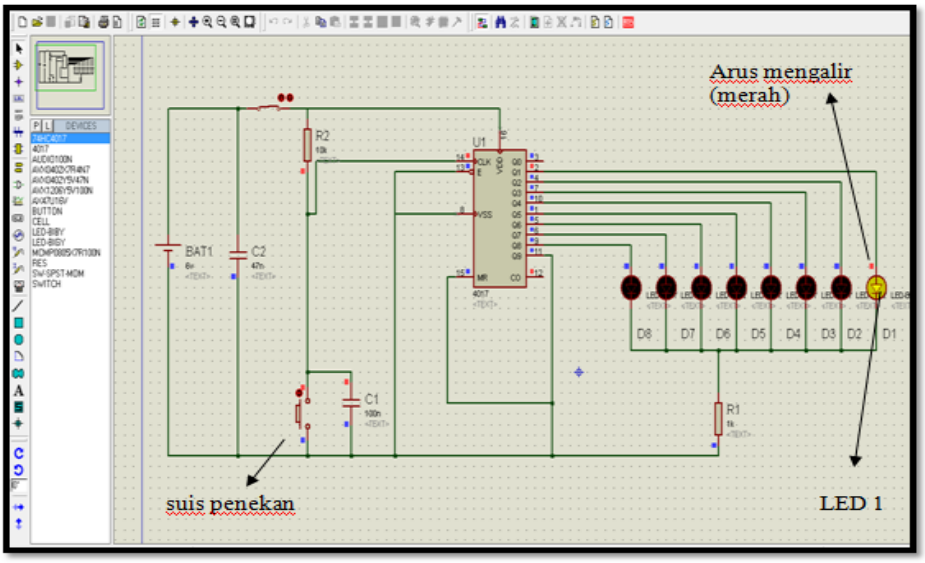

Fig. 4: Electronic circuit of the prayer counter

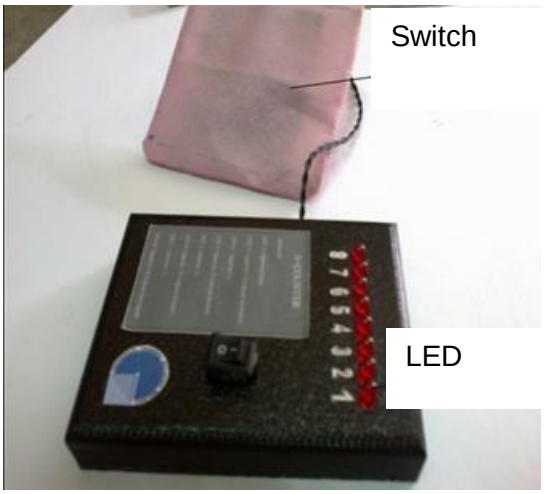

Fig. 5: Prototype of the prayer counter

PRODUCT EVALUATION

Product evaluation is an important aspect of the product development process, to measure the acceptability of product in the market, before production. The initial evaluation of the prayer counting device was carried out on twenty potential users. All participants of this evaluation were students from Universiti Teknikal Malaysia, Melaka. In the beginning, they briefed on the function and application of the product. Later, they were asked to answer questions on an evaluation form. In general, the questions were related to the acknowledgment and willingness of the participants to the product. They were asked about their feelings and acknowledgment of the product. In general, the majority of the

respondents acknowledged the existence of the prayer counter.

CONCLUSION

This paper describes a method for systematically considering important issues during the design and creation of a prayer counter. The design, construction, and preliminary evaluation of the product were accomplished with success. Before beginning the design of a product, design engineers must consider the product's pertinent factors. Consideration of all pertinent issues aids in identifying the product's customer/user requirements. The product's preliminary evaluation revealed that the existence of a prayer counter was well received by prospective users. However, users may require additional product enhancements.

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