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Sanitary Napkin Wearing Aid for Women with One Functional Hand

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Abstract

Activities of daily living (ADL) often pose significant difficulty for physically challenged people. Inability to perform certain ADLs independently viz. toileting, bathing and personal hygiene, can affect an individual's privacy, dignity and self-esteem. Use of sanitary napkins is essential for women in child-bearing age; but, it involves significant dexterity and coordinated use of the two hands. An woman whose one hand is dysfunctional, viz. amputees, stroke-induced hemiplegia or congenital disorder, would find it difficult to do or seek help for. Even advanced prosthetic devices may not help the amputees much, and stroke rehabilitation is a long process. Therefore, a design intervention is imperative to save the dignity of such members with special needs in our society. The proposed design enables subjects with one functional hand to use a common sanitary napkin with a sticky patch for attaching it to knickers. It is basically a structure with two foot-rests and a raised portion in the middle for supporting the central narrow region of lowering knickers, and placing the opened pad for pressing and sticking. The same device also aids in removing, rolling and wrapping the used napkin with one hand. The design is sized to accommodate different anthropometry and napkin sizes. The effectiveness of the device has been tested

Keywords: sanitary napkin; upper-limb dysfunction; aid for ADL; inclusive design

1 Introduction

Our environment and products have been designed predominantly for two-handed people! Unfortunately, more than 1 billion people (about 15% of the world's population) in the world have some form of disability and about 10 million are amputated, which includes about 30% arm amputees (LeBlanc, 1973; LeBlanc 2008) In such persons with one ineffectual arm, approaches have to be modified (Doncaster, 2013) to enable them to perform their tasks with one hand.

Although the exact figure for arm-amputated women is not available, short term and long term arm-dysfunction, due to conditions such as stroke-induced hemiplegia, accidents leading to fracture and injuries, trauma and paralysis, leaving women with affected functionality of their arm are much larger. Persons with disability usually depend upon care-givers for their activities of daily living; however this has psycho-socio-economic implications, especially

among women. For a woman, maintenance of hygiene during periods is of prime concern; for women with disability (Campling, 1979), the psycho-social impact, embarrassment and privacy concerns calls for *a design intervention to provide them with an intervention that enables them to carry out the task using one functional hand without relying on a care giver.*

Wearing a conventional sanitary napkin on a regular knickers involves bimanual skilful operations with fingers delicately opening, folding and pressing different portions of the napkin ensuring proper positioning without wrinkles. The disability of one hand due to *various reasons* would affect this task significantly. One could develop a novel sanitary napkin that could be easily managed with one hand. This approach has significant challenges in view of the evolution of the product over a century (Conger, 2015; Finlay, 2001; Ghosh, 2013; Scott et al, 2013). Also, availability of such a product in the market, if at all, would take very long time. Moreover, since the user group is relatively small, it may not mean good business. The work presented in this paper pertains to a light-weight, low-cost, portable support device to enable a female user with only one functional hand to change her sanitary napkin with substantially reduced effort and enhanced hygiene without altering the conventional napkin or its usage method.

2 Problem Analysis

In order to address the issues concerning changing of sanitary napkins using only one hand, it is necessary to first understand the *nominal usage pattern*. We envisage that there would be variations due to the design of the napkin itself, the individually adopted styles of usage, cultural bias and garments used. Subjects recruited were able bodied Indian women with both functional hands; female subjects with arm-disability were not involved at this stage of the study. Since the present study pertains to a class-room project, survey forms were distributed among female students of the institution for identifying primary design requirements. The age of the subjects varied from 18 to 36 years. 40 subjects participated in the questionnaire (as in Appendix.A at the end of the paper) based study. A brief summary of the responses from the survey which are of direct relevance for the design in context is presented below.

2.1 Posture while wearing

From the survey it is found that subjects preferred standing posture during changing the sanitary napkin. In this context it may be noted that commode is not a common facility in Indian toilets. Significant number subjects carry out this activity while sitting on a commode and in squatting posture. For some subject the posture did not matter much as they felt it was comfortable to change it in any position. The distribution of the preferred postures as per the pilot study is shown in Figure 1.

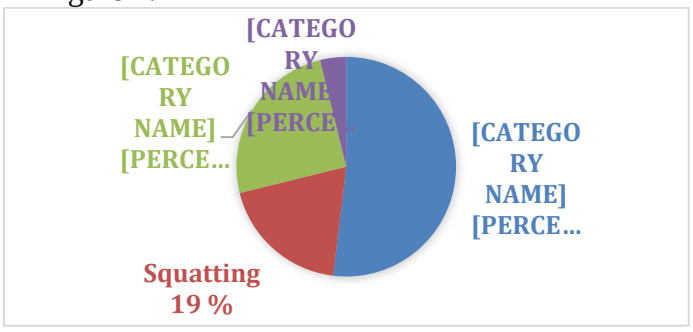


Figure 1. Postures preferred by subjects for changing napkin.

2.2 Steps for Sanitary Napkin Wearing and Removing

Description of the steps, as mentioned by subjects, are summarised as follows.

2.2.1 Wearing/ changing

1. Get in comfortable position: Sitting for comfortable reach.
2. Holding napkin in one hand and peeling off wrapper with another.
3. Fold out flaps/wings.
4. Align the pad to the central line of the underwear.
5. Position to most effective area.
6. Unfold wings to other side of undergarment and stick it.
7. Wear underwear as usual.
8. Wash hands for better hygiene.

2.2.2 Removing/Disposing

1. Get into a comfortable/convenient position.
2. Fold the back wings (detach).
3. Pick a corner of the longer axis of the pad and roll the used napkin.
4. Dispose by wrapping in a paper or the pouch typically provided with the napkin.
5. Wash hands for better hygiene.

Due to the strong association of the activity with privacy and the social stigma associated with it, the details in the operation through direct observation is not possible. Subject specific variation is also likely to be there as use of napkin is mostly learnt by doing. While above mentioned steps are common, some subjects do follow self-developed steps, e.g., while removing the used napkin, they place the wrapping paper over it and rolling the pad along with the paper.

2.3 Perceived difficulties of using sanitary napkin with one hand

Since there were no subjects in our study with only one functional hand, direct feedback from the target user group was not possible; for normal subjects, empathy and possibly role-playing primarily governed the perception about difficulty in doing the operation one-handed. It was no surprising to note that most of the subjects felt that it was possible to use the sanitary napkin with one hand; but, it would be difficult. Some subjects felt that they might need to take help of others to do the activity. The difficulties envisaged by the subjects in different steps while using the sanitary napkin with one hand are shown in Table 1.

Table 1. Subjects responses for possible problems using napkin with one hand

Steps	Difficult with one hand	Responces out of 40
1	Peeling of wrapper	18
2	Alignment and positioning	17
3	Sticking to underwear	16
4	Wearing underwear	2
5	Removing used napkin	9
6	Dispose (folding and wrapping)	8

For the purpose of the initial design, the responses of the normal users as in Table 1 were used for prioritizing the primary challenges to be overcome by our design.

3 Design approach

Wearing sanitary napkin is a bimanual operation involving hand-eye coordination for fixing it onto the underwear with proper alignment and position. Improper alignment would lead to leakage which causes discomfort and embarrassment, and improper position would make undesired contact with the skin which causes itching and rashes. Therefore, alignment and positioning of the napkin are the primary aspects to be ensured by design.

3.1 Design Requirement

3.1.1 Usage Scenario

The goal of the design is to enable the user to change sanitary napkin with *one hand* while at home or away. It should maintain *privacy*, operate in *minimal steps*, be *compact* to carry and facilitate safe disposal. Since the target user group would be involved in diverse activities, the typical operational environment is a toilet in schools, colleges, offices, hospitals etc; therefore, the design *should not be affected by water*. While on travel, the users typically carry napkins with them. Since the device is an additional item, it should not demand much additional space. To enhance privacy, the appearance of the device should be *non-conspicuous*.

According to importance of each parameter, all considered parameters are categorized into demands and wishes. Where demands must be satisfied and wishes can be fulfilled after demands. List of parameters described below in Table 2.

Table 2: Design Requirements

Sr. No.	Parameter	Demand/Wish
1	One hand operation	D
2	Compact and portable	D
3	Maintaining privacy	D
4	Water resistant material	D
5	Low cost	D
6	Aesthetic	W
7	Low maintenance	W
8	Space for extra napkin	W
9	Space to store wrapper	W

3.1.2 Posture selection

According to user study, standing is the preferred position for most subjects. But it is influenced by cultural aspect of society as commode usage is not so popular in region surveyed. The authors believe that when one has to change sanitary napkin with only one functional hand, then sitting is the most convenient position. Hence in our design we consider sitting as preferred posture.

3.2 Material Decision

Focus of this project is also on making the product portable so that woman can use it while travelling or in office. So weight of product does matter hence material. And it is associated

with personal hygiene, so material should be washable, anti-bacterial, durable and light weight.

3.3 Extra features provided with product

3.3.1 Space for Extra Napkin

User study that we conducted shows that subjects need three changes in a day on an average. They need to carry two or three sanitary napkin with them while travelling, in schools, colleges, office, etc. So we decided to provide some extra space in product itself to keep these napkins.

3.3.2 Disposal

Sanitary napkin is meant to be disposed after use by placing into a sealed bag or wrapper provided with the napkin into a separate trash bin. They are not designed to be flushed down the toilet; there is a risk of consequential plumbing or sewer blockage and potential flooding if this is done. From the study, we found that women do not carry wrapper after peeling it off from napkin, so we decided to provide space in the product for keeping the wrapper and use it later for disposing the used napkin.

3.4 Design of the Sanitary Napkin wearing aid

3.4.1 Important parameters in design

Design requirements gives some parameters to consider for generating concepts. As desired product should have compatibility with one hand operation, minimum operation steps is important parameter for ease of use. While changing napkin subject neeeds to press napkin against seam of underewar, it requires support of other hand. As problem is focused on hand amputees, platfom which provide support is needed, rigid platforrm to provide reactive force against pressing hand.

Form of product should depict a feminine identity and the aesthetics should have the attributes such as clean and hygienic such that the user can relate the product to its use. Napkin changing operation is always done in closed environments, due to strong privacy concerns product will always be private. Considering primary goal of the product is functionality, importance to aesthetic can be given low at this stage. The relative importance assigned in **Table 3** ranged from 1 to 5 with 1 being of lowest and 5 being of highest importance. Importance of parameters are decided by authors after discussing it with subjects.

Table 3. Parameters and relative importance

Sr. No	Parameter	Expectation	Relative importance: 1-5
1	Operation	Single hand	5
2	Maneuverability	Portable	4
3	Accessibility	Private	4
4	Aesthetic	Feminine	3
5	Durability	Long life	4
6	Manufacturability	Simple	3
7	Maintenance	No maintenance	4
8	Weight	Light	4
9	Cost	Inexpensive	5
10	Added space for reserved napkin		2

11	Pocket to keep wrapper paper		3

3.4.2 Concept generation

From usage scenario and design requirements, some essential parameters considered as demands. All concepts must satisfy this parameters, wishes on the other hand can be added advantage to design. In concept exploration we mainly focus on rigid platform to support sticking operation to maintain stability of product leg space may be required. Saving space by compact design can be explored by folding or using product as individual entity.

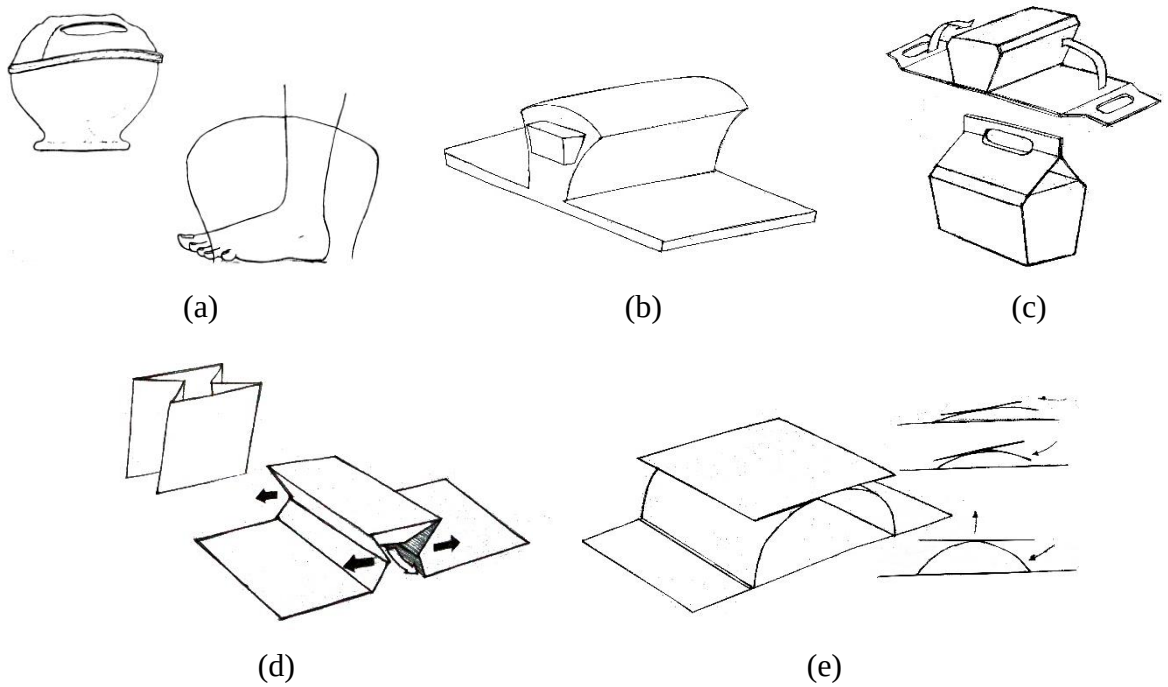


Figure 2. Exploration of different concepts

Initial ideation is focused around a platform to support the underwear. In concept (a) we used inverted bowl form having space to put leg inside as shown in fig a, after stepping in, user has to unroll underwear on it. Platform will provide rigid support against pressing force. This concept can be easy to use but product will be bulky to carry.

Concept in Figure 2(b) is rigid inverted 'C' structure having room for legs and raised platform. User need to step on the base in sitting position; then lower the underwear on a raised support to keep the crouch seam in position, while keeping the fabric in stretched condition with the legs. The unibody design is expected to facilitate doing the activity effectively.

Concept (c) is basically a handbag structure which has collapsible side flips and having space for keeping extra napkins. The platform in this concept is similar to that in concept (b) and procedure is also similar. This one has an added advantage of portability and storage space.
In concept (d), focusing on portability, we tried to make the product completely foldable into a slab. Unfolded product will provide a rigid support and when collapsed it will be a single plane slab. The fins, when folded below, provide the necessary rigidity to the platform.

To make the folding operation simpler, and to reduce the number of components, concept (e) is proposed which has three components. Platform is mounted over flap which is raised after fixing onto the base as shown in Figure 2(e).

3.4.3 Concept selection

Elements required for evaluation of concepts are the presence of alternatives, consequences of alternatives and desired consequences. Some parameters for comparison are quantitative such as cost and weight, while some parameters are qualitative such as aesthetics, maintenance and durability. To evaluate the concepts for ranking, all parameters needs to be quantified by respective effectiveness. Effectiveness is indicated in a scale of 1 to 9 (9=very well, 8-6=well, 5=ok, 4-2=moderate, 1=none).

Weighted objective method has been used to rank the concepts. Parameter importance (k_i) is calculated (**Table 5**) by comparing parameters to each other for priority. Effectiveness of concept is then calculated by multiplying relative value and k_i and summing the values up.

Key							
P1	Operation	P3	Accessibility	P5	Durability	P7	Maintenance
P2	Maneuverability	P4	Aesthetic	P6	Manufacturability		

Table 4. Key assigned to parameters

Table 5. Determination of weightage for the parameters

	P1	P2	P3	P4	P5	P6	P7	Sum	weightage	k_i
P1		1	0.5	1	1	0.5	1	5	0.24	24
P2	0		0.5	1	1	0	0.5	3	0.15	15
P3	0.5	0.5		1	1	0.5	1	4.5	0.21	21
P4	0	0	0		0.5	0	1	1.5	0.07	7
P5	0	0	0	0.5		0.5	0.5	1.5	0.07	7
P6	0.5	1	0.5	1	0.5		1	4.5	0.21	21
P7	0	0.5	0	0	0.5	0		1	0.05	5

Table 6. Weighted objective method

Parameters	P1	P2	P3	P4	P5	P6	P7	Sum
k_i	24	15	21	7	7	21	5	$\sum k_i P_j$
Concept (a)	7	2	6	5	6	4	4	505
Concept (b)	8	2	6	6	6	5	6	567
Concept (c)	8	9	8	7	5	5	6	**714**
Concept (d)	7	9	8	5	5	4	7	660
Concept (e)	7	8	7	5	6	6	7	673

From evaluation of concepts based on the chosen parameters, concept-(c) which scored the highest (**Table 6**) was taken up for further development.

3.4.4 Geometry of Product

To decide the dimensions of product, different sanitary napkins available in the market are examined. Napkin size is given in terms of its length and width as given in **Table-7**.

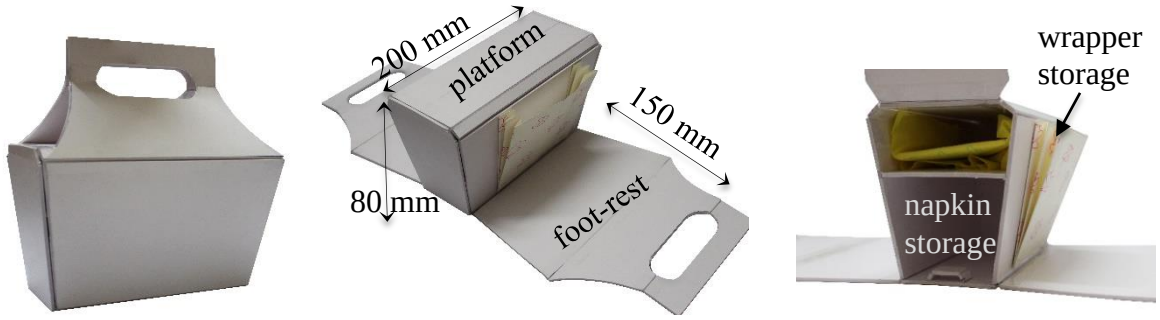
Table 7. Dimension specifications of different sanitary napkin brands in market

Brand	Size	Length (mm)	Width (mm)
Caremate	Regular	210	60 to 75
Carefree	Regular	185	
Stayfree	Regular	208	
Kotex	Regular	200	
She	Regular	197	
Whisper choice	Regular	201	
Don't worry	Large	239	
Sofy	Large	225	
She	Extra large	257	

Based on the data in the table and assumption of typical usage pattern, the dimensions of the product is decided as shown in Figure 3.

3.4.5 Selected concept prototype

The functional prototype of the device is made for concept 3, using paper-faced foam board since it is easy to work with and also provides sufficient stiffness for testing. It does not consider actual material and manufacturing process for the design. Different views of the prototype are shown in Figure 3. The top platform in Figure 3(a) on which the napkin rests is 200mm x 80mm. Height of the platform is 80 mm for easy reach while seated on a commode. Foot-rests are 200mm x 150mm.



(a) (b) (c)

Figure 3. Prototype of napkin changing aid

3.4.6 Testing of the prototype

Since real usage of napkin is highly personal matter, prototype testing was done through role playing by one of the authors of the paper, who is a male. The intended method of usage is described pictorially in Figure 4 and Figure 5 below. Appropriateness of the steps and the method was found to be acceptable by the female subjects. For evaluating effectiveness of the design, more rigorous user study could not be conducted at this stage. It is planned for future.

(a) (b) (c)

(d) (e) (f)

(g) (h) (i)

Figure 4. Steps while wearing; (a) place device on floor in a suitable position, (b) place feet on horizontal flaps, (c) take napkin out from storage, (d) remove napkin from wrapper, (e) keep wrapper in wrapper storage, (f) place and align knickers on platform, (g) place and press napkin on required area of knickers, (h) stick flaps around the rim, (i) pull-up and wear knickers as usual

(a) (b) (c) (d)

Figure 5. Steps for disposal; (a) place knickers with used-napkin on platform, detach side flaps, (b) detach and roll napkin, (c) put rolled napkin in wrapper, (d) dispose

4 Conclusion

In this paper, we have proposed an aid to assist women with only one functional hand in wearing and changing a common sanitary napkin. After conducting a survey for current usage of sanitary napkins, the collected data was utilized in generating the design requirements and selecting posture while using the product. Systematic design procedure is followed in designing the aid through steps from requirement identification to prototype testing.

The proposed design satisfies all design requirements. It effectively enables use of sanitary napkin with one hand while maintaining alignment and positioning of sanitary napkin on underwear easily. The device can store additional napkins and one used wrapper which can be used during changing to dispose it later safely.

This product is designed for squatting as a posture for usage; efforts are on towards a design for standing posture. The present design is probably too big to be carried in a handbag. Efforts are on for a foldable and more portable design.

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A. Appendix: Questionaire Survey

Relevant portion of the questionaire for questions posed in the survey:

1. Age: …….
2. How many years you have been using sanitary napkins?……
3. What kind of napkin you prefer? (Tick)
   - With adhesive base
   - Without adhesive
   - With wings
   - Any other (specify) ……
4. Usual number of mandatory steps involved in changing napkin. ……
   (ex: opening door lock have 3 major steps. Inserting key, rotating it and removing lock)
   Descriptions of steps: Wearing:…… …… Disposing:……
5. Average number of Napkins need to be changed in a day? ……
6. If out-station trip, how many napkins do you carry? For a day trip:…..For full period:…..
7. Sizes of napkins carried: Small:……Medium:……Large:……Extra Large: ……
8. What is preferred posture for wearing? (tick all relevant)
   - Standing
   - Squatting
   - Sitting on chair
   - Sitting on commode
   - Any other (specify) ……
9. How do you dispose napkin after use? ……
10. Usual operation needs both hands? (Yes/No) ……
11. Is it possible to change it with one hand? (Yes/No) ……
12. What can be possible problems if one needs to change it with one hand? (e.g.: peeling off wrapper) …….....