Design & Development of Smart Clothes Drying System (Scds)

S.A.Sundi, M.S. Jumali, M.R. Yunos, M.Z. Ahmad

ABSTRACT: ***Smart Clothes Drying System (sCDs) is a specially designed of mini movable closet with complete integrated smart system to utilize the waste heat dissipated by condensing unit of split residential air conditioner for clothes drying purpose whilst using in the night time. Meanwhile, in the day time the system is easily push-able to sun-lighting areas in order to utilize the sunlight as well as the air flow as the two main drying agents just like our current conventional method of drying clothes today. The system shall automatically close and secured the clothes once the sensors triggered few droplets of rains. From the result of comparison made between conventional drying method andsCDs, there was significant reduction of drying duration up to 40% with sCDs in the night time by utilizing the waste heat from condensing unit of split residential air conditioner. Ultimately, with this newly system makes drying clothes is now more flexible, energy saving and easier than before.***

KEYWORDS: ***clothes drying system; smart open close integration system; waste heat utilization.***

1. INTRODUCTION

The situation of the atmosphere of Malaysia are uniform temperature; high dampness and plentiful precipitation and they happened fundamentally because of the maritime presentation of the nation. Winds are commonly light. Arranged at the tropical doldrums region, it is very uncommon to have an entire day with totally cloudless sky even in times of serious dry spell.

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Then again, it is additionally uncommon to have a stretch of a couple of days with totally no daylight aside from amid the upper east rainstorm seasons. Attire is one of the fundamental requirements for human [2-6]. Garments shields human body from boundaries climate and for wellbeing purposes. Each time the garments are utilized, it should be cleaned before it very well may be utilized once more. This to guarantee the garments are sterile and free from risky microscopic organisms. It is a daily practice for one to wash and dry their garments consistently. As an ordinary technique, sun vitality is being used as a noteworthy source to dry garments. It is in every case at times raining and different seasons are continue evolving. In addition, individuals are getting busier and in this manner need to work more enthusiastically because of the effect of worldwide monetary change. This circumstance compelling both a couple to work to get by in a urban city. Clearly, no time for them to wash and dry their garments. Consequently, a keen drying garments framework is proposed to experience these issues called Smart Clothes Drying System (sCDs).

In thickly assembled urban territories in the damp tropics, drying of garments is turning into a dangerous family unit errand. In most elevated structure pads, it is constant devouring activity on account of the all year damp atmosphere, constrained sun beams and limited wind stream. Figure 1 clarifies this circumstance. Moreover, in the muggy tropics, sunlight based radiation, when accessible, is generally of the diffuse kind and, subsequently, less viable for drying purposes. The utilization of a regular household electrical dryer is a pragmatic however costly answer for garments drying, as it is innately a vitality escalated process. Henceforth, a scan for an ease arrangement of drying garments for such cases is very pertinent and all the more so with regards to the worldwide worry for vitality preservation and security of the earth. [1].

2. METHODOLOGY

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Start with ideation stage, the general look of the whole framework is planned. Pursued by reasonable plan and last structure is chosen by applying Pugh Method network investigation after a few conceivable structures have been broke down. The idea choice used a choice grid technique which depends on contrasting the requirements or wishes and the ideas as represented in the Figure 2. The idea determination used a choice framework strategy (Pugh technique) which depends on contrasting the necessities or wishes and the ideas. The Pugh strategy tests every idea for culmination and designs new ideas from past ones. A model must be picked for contrasting ideas. So as to rank the ideas, they should be appraised against a benchmark structure. This plan is either a past structure or an idea that is an undeniable answer for the issue. The ideas are evaluated to be either superior to (+), equivalent to (0), or not exactly (-) the datum idea. After the ideas are scored the scores are classified. The pluses and minuses are meant every idea. At that point the contrast among pluses and minuses are checked; this is the general aggregate (Pugh, 1990). Table 1 beneath demonstrates the screening consequence of Pugh Method framework examination.

Figure 1: Drying of clothes in high rise flat [source: http://our-permaculture-life.blogspot.my]

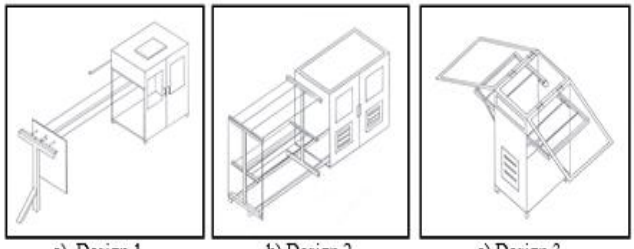

Figure 2: Conceptual designs

From Table 1 it is clearly indicated that the Design 3 is the best design to be chosen for the next phase called Detail Design stage. Detail designof the chosen Design 3 is made using CATIA simulation software to portray an idea or concept of system that operate automatic opening and closing of the side doors.Figure 3illustrates the full view of the prototype.The system is embedded with water sensor that read the water presence as a command to send a signal for a motor to rotate anti-clockwise to open the door, and rotate clockwise to closed the door otherwise.

Selection Criteria	Conceptual Design 1	Conceptual Design 2	Conceptual Design 3
Economy	**0**	**0**	**0**
	average	average	average
Weight	+	--	+
	Light, cable as hanger	Heavy, many frame	Lighter than design 2
Thermal Resistance	+	-	-
	Place under roof	Place under direct sun, reduce life time	Place under direct sun, reduce life time
Material	+	**0**	+
	Wood, thermal resistance	Wood and acrylic, expensive	Mainly from acrylic, better than wood
Ergonomic	0	0	0
	average	average	average
Ease of handling	+	+	+
Ease of manufacture	--	-	++
	Fixed, need expert to assemble	Need to assemble many parts	Less part compare to both design
Sum +'s	4	1	5
Sum 0's	2	3	2
Sum -'s	2	4	1
Net Score	2	-3	4
Rank	**2**	**3**	**1**

Table 1

The screening matrix for the conceptual design of the Smart Storage System

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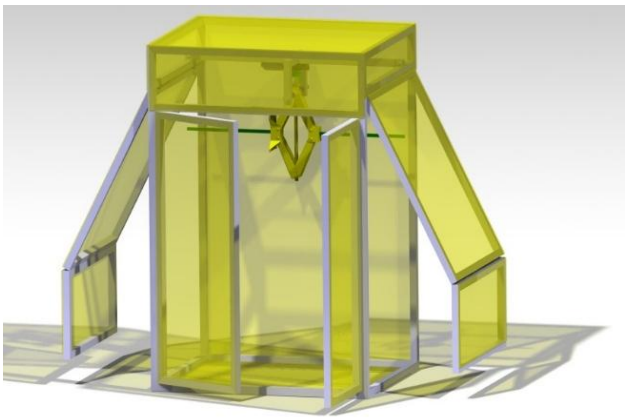


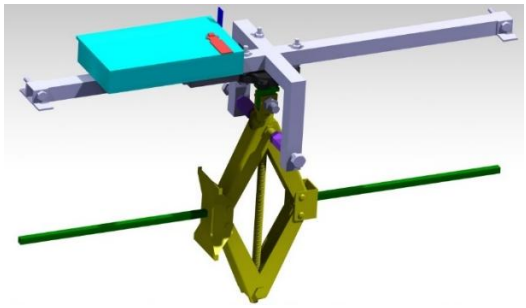
Figure 3: Overall concept view of prototype Smart Drying Clothes System

On the other hand, Figure 4 exhibits the overall mechanism which consists of two main separate parts; namely electronics and mechanical parts. The figure below is an illustration of electronic component enclosed in blue box which is made using acrylic, while mechanical part is the main mechanism to open and close the door using expansion and compression mechanism of modified scissor car jack.

Enclosed electronic box contain arrayed electronic components, which includes Arduino board, motor controller, water sensor and Bluetooth module. The water sensor function is to sense the present of water droplet and send a signal to Arduino board and finally command the motor to start moving either clockwise or counter clockwise. The use of motor controller is mainly to control the rotation of motor.

3. RESULTS

The prototype of smart clothes drying system is successfully developed involving few typical manufacturing processes such as measuring, shaping, bending, squaring, welding, riveting and painting for finishing process. On the other hand, the main electronic components include an Arduino UNO R3 board, motor driver circuit and water sensor devices. The assembly process for electronic components used soldering joint process and connection through wire jumper. Figure 5 illustrates the completed prototype.



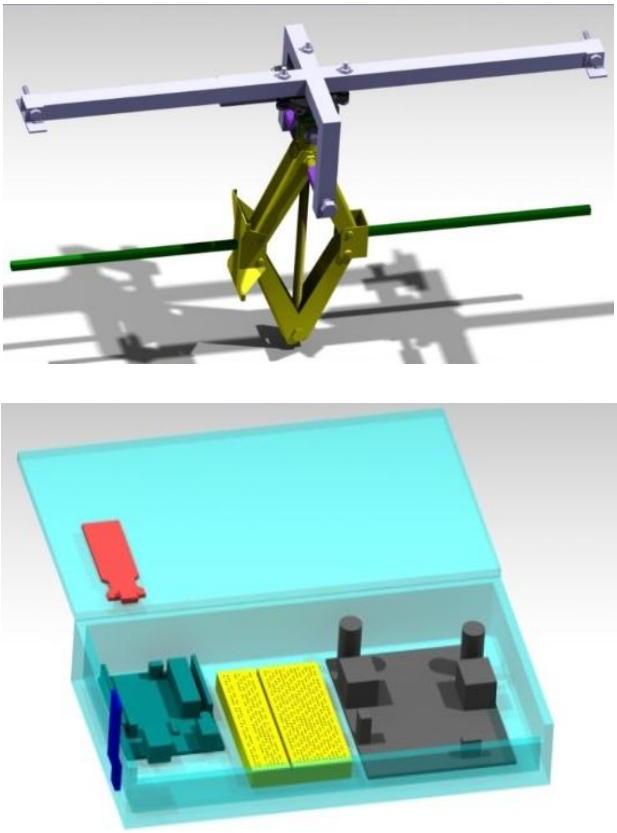


Figure 4: Overall mechanism of Smart Drying Clothes System

Field testing was conducted on the prototype to validate the drying effectiveness and its functionality [7]. The first test carried out was comparison to the current conventional drying method in the day time utilizing the sunlight as well as the air flow as represented by the data shown in Figure 6 (a). Meanwhile, the second test done was in the night time where the prototype is connected [8] to the condensing unit of residential air conditioner in order to utilize the warm air dissipated by the unit for drying purpose as represented by the data indicated in Figure 6 (b) [9].

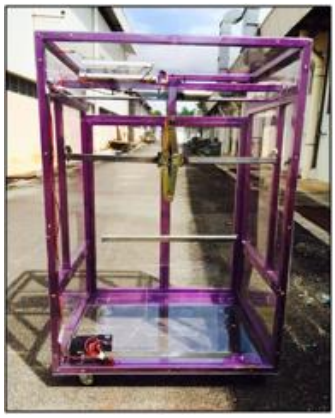


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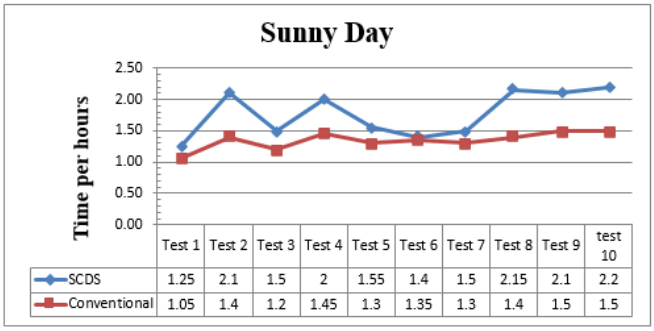
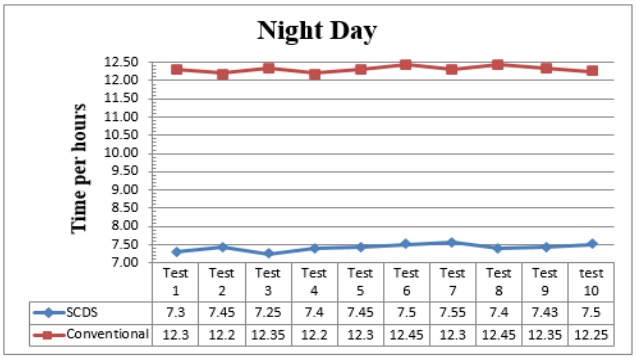
Figure 5: The prototype; Smart Clothes Drying System (sCDs)



(a)



(b)

Figure 6: Comparison data of drying time (a) day time (b) night time

Referring to the Figure 6 (a), the time taken to dry using conventional drying method seems to be slightly better than the prototype by the difference of approximately less than two (2) hours in average. This is believed due to the aids of free air flow and winds that boost up the drying time. Clothes in the prototype restricted only to the horizontal air flow across the system [10]. On the other hand, significant difference obviously portrayed from Figure 6 (b) when the drying taking place in the night time. It is proven that the warm air dissipated by the condensing unit of the air conditioner does significantly affects the drying time to be compared to the conventional drying method by a huge difference of approximately five (5) hours. Having said that, the most important finding which can be deduced from the result is the significant effect of utilizing the waste of warm air dissipated by the condensing unit of residential air conditioner.

4.CONCLUSIONS

This paper presented an idea of design and development of smart clothes drying system prototype which the main idea is to utilize the warm air dissipated by residential air conditioner whilst being used in the night time. Meanwhile, in the day time the system is easily push-able to sun-lighting areas in order to utilize the sunlight as well as the air flow just like normal practice in conventional drying clothes today. The system is designed to automatically closed and secured the clothes once the sensors triggered few droplets of rains. From the result obtained, it is significantly proven that the hot air dissipated by the condensing unit improves drying duration whilst using the prototype in the night time.

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