

Smart Roller

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ABSTRACT

Painting is part of construction activities. Painters usually use brushes or paint rollers to paint buildings, bridges, and other structures. Large flat surfaces are usually painted with paint rollers. On the other hand, brushes are used to paint small and difficult to reach areas. Obviously, painting large areas with paint rollers are faster than using brushes, but paintings with paint rollers still consume a lot of time and movements. The painter needs to do dipping the roller sponge into the paint and rolls it on the wall surface. These movements are repeated until the job is finished. This also means that the painter needs to do a lot of bending and stretching. Therefore, an innovation is needed to make paint roller a more user friendly painting equipment in the construction painting. The objectives of this study is to introduce an innovative paint roller that does not need dipping the roller sponge into the paint, less movement and less time consuming. In the process, several designs were made and the one that supply the paint continuously to the roller sponge was chosen. The design was then turned into a prototype. Several tests were made to find out the workability of the new roller, number of the movements and time used to do painting compared with the traditional paint roller. Finally, the innovated paint roller which is called Smart Roller is introduced as an automatic paint roller. The new roller requires no dipping the roller into paint, less movement and saves time in painting a surface.

KEYWORDS: Paint Roller, Dipping, Sponge, Painting, Movement, Surface.

INTRODUCTION

Painting is one of the construction works. The painting activity comes near the end of any construction project. Painters start their painting after wall plastering and tiling. The work is then followed by electrical and external work. The purposes of applying paint to walls, buildings and other structures is to get good finishing and for the protection of the structure [2]. It prevents fungus and erosion from damaging the surfaces due to weather and climate. It also improves aesthetic values of the building that will make it more attractive and vibrant [8].

Normally, painter uses a brush or a paint roller as a tool to paint surfaces of houses, buildings or other structures. The process involves dipping a brush or a paint roller into the paint and applying it to the building surfaces. These also involve climbing, bending and stretching in the painting process. This process usually takes a lot of movements and time.

Problem Statement

Painters usually experience stress to the body parts due to repetition of the movements such as climbing, bending and stretching. The body parts that are used repetitively during painting, such as painting ceiling and walls, are forearm, wrist, hand and shoulder. These are the body parts that are most likely to get injuries. House painters in a construction project are the one who commonly suffer shoulder fatigue musculoskeletal disorder [7].

Research Objectives

The objectives of this study are to:

- to design an innovative paint roller that does not involves dipping the roller sponge into the paint.
- to evaluate the improvement made when using the innovated paint roller on the number of movements.
- to evaluate the time reduced when using the innovated paint roller.

Scope of Study

The scope of the study is to build an innovative paint roller that could improve house painting. The innovative paint roller should function better than the conventional paint roller, more ergonomic and less time consuming. Water based paint and house concrete wall are used in this study.

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LITERATURE REVIEW

The real image of a house that is under construction will not emerge only after the house is painted. Painting is very important because it gives protection and as decoration to the house. Firstly, the colour and the type of the paint are chosen by the owner approval. It should show the beauty of the house and hide the flaws. Secondly, the painter will choose the proper painting tools. Then, he will make preparation for the surfaces. Lastly, the painter will start the painting job.

Painting Tools

Most popular house painting tools are paint brushes and paint rollers[1]. The choice of the tools whether to use paint brush or paint roller depends on the painter. The painter will choose accordingly to the type of surfaces that is needed to be painted.

There are two types of paint brushes available in the market. The brush types depend on the materials that they are made of. Either it is made of natural bristle from animal hair and the one that has synthetic bristle made of nylon. Usually the painter will use the one that is made of natural bristle because it is better than the synthetic bristle. The only downside of it is that it is also more expensive [3]. It is used to paint the entire surfaces and also spaces that need fine details [9]. Paint brushes come in different sizes, such as 1, 1.5, 2, 3, 3.5 and 4 inch wide brush.

On the contrary, paint rollers are used to paint large and flat surfaces. The paint rollers enable the job to be done faster than paint brush [6]. The size of the roller depends on the paint roller width; it ranges from 4 to 18 inches. The roller with 7 inches and 9 inches width are the two most popular sizes of the roller. Usually, paint roller is used together with paint tray.

Paint Types

There are two types of house paints available in the market, they are water based and oil based paint [10]. There are advantages and disadvantages for each type of the paints.

The oil paint finishing is harder and has a better resistance than the water based paint. Unfortunately, the paint has a strong odour, takes a longer time to dry and need paint thinner for cleanup. It is also tends to crack easily. The oil paint is not suitable for damp surfaces.

The other name for water based paint is latex paint. The paint is durable, fast drying, low odour, easy to apply and can be easily cleaned with soap and water. It is has no problems to be used for places that are exposed to moisture. The water based paint has less tendency to crack because it allows the surface of the paint to breath.

Paint Application

Certain procedures have to be followed when applying the paint to ensure to obtain the best house painting results. These painting procedures should be followed as stated as below [8].

- Make sure that the surface area is clean, smooth, dry and sound.
- Paint must be stirred thoroughly before use. Thinning agent should be used to dilute paint if necessary.
- Paint is only applied when the weather is hot, dry and non-dusty.
- Apply two coats with a brush or roller.
- Apply the final paint.

Malaysian Public Works Department stated that a painter salary is about RM70.00 to RM75.00 per day [5].

Paint Defects

Almost all of paint defects can be detected through eye examination. Identify, the cause of the defects before any treatment is to be done. The defects could be caused by poor surface, bad application of the surface or chemical reaction [2]. Dampness in walls could be caused by ground moisture, leaky roof, rain water, moisture trapped in bricks and hygroscopic salt used in the building materials that absorb moisture from the atmosphere [4]. The treatment of paint defects are usually started by removing the affected paint and preparing proper surface for painting. This preparation must be made before the correct paint is applied. Below are some examples of paint defects [2].

- Bleeding-applying incorrect paint over another causing chemical reaction that resulted staining. Remedy is to apply the correct overcoat pain after removing the affected paint.
- Blistering-entrapped liquid materials that expand causing the defects. Remedy is to remove the defected paint, repainting after the surface dried.

- Blooming-the presence of moisture on high gloss or varnished surfaces causes dullness. Remedy is removing the affected paint before repainting. Painting is done when there is no more moisture.
- Chalking-low quality paint or old paint causing powdering on the paint surface. Remedy is repainting after removing the affected paint.
- Cracking and crazing-unequal elasticity of paint causes cracking and crazing. Remedy is repainting after removing the affected paint.
- Flaking and peeling-poor adhesion, moisture and unclean surface causing flaking and peeling. Remedy is repainting after removing the affected paint.
- Grinning-the colour of undercoat paint background can be seen. Poor thinning is the cause of grinning. Remedy is to reapply the paint.
- Saponification-caused by the formation brown soapy liquid and the presence of alkali. The paint is total loss. Remedy is to remove the affected paint, clearing the alkali and repainting.

METHODOLOGY

Design

The paint tank and the innovated paint roller are two main parts of the Smart Roller. These two parts are needed when using the Smart Roller. The paint tank consists of paint tank and aluminium casing. The paint tank will be filled with paint. The aluminium casing will be placed with a battery and a water pump. The battery is for powering the water pump. When operated, the pump will supply the paint to the paint to the paint roller continuously.

The innovated paint roller consists of clear hose, roller sponge, controller and handle. Then the paint will flow continuously through the clear hose to the sponge. The controller will control the flow of the paint to the sponge. The sponge is the applied to the surface to do the painting.



Figure 1: Smart roller

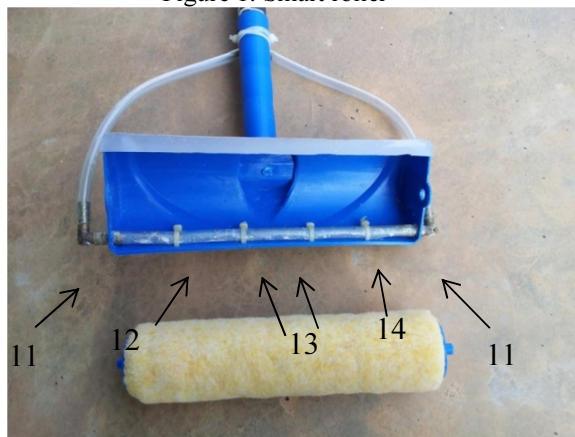


Figure 2: Bottom part of smart roller

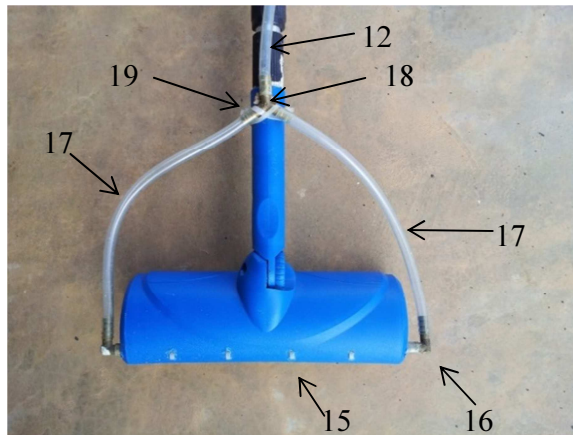


Figure 3: Top part of smart roller



Figure 4: Controller



Figure 5: Back of aluminium casing



Figure 6: Inside of aluminium casing

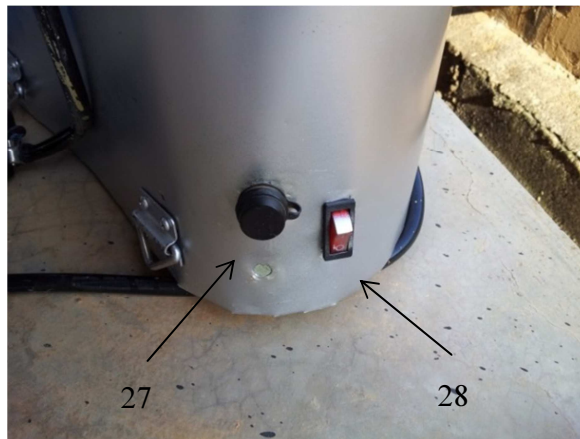


Figure 7: Switch and charger plug



Figure 8: Back of paint tank

Construction

The construction of the Smart Roller needs cutting, gluing, fitting, finishing, powering and pumping. These tools are needed for the construction of the Smart Roller: iron saw, measuring tape, drill, file, silicon glue, soldering iron, glue gun, knife, tank, electric water pump, battery, 12V, battery charger, clear hose, 8mm diameter, paint roller, switch, screw driver and black hose with 8mm diameter. The construction of the Smart Roller is explained such as below:

- Drill holes (11) at both sides of paint roller casing 10mm from the bottom and 10mm from the front with 8mm drill bit.
- Cut clear hose (12) of about 25cm in length.
- Make 8 holes (13) evenly length of about 30mm from each other.
- Make 4 pairs of holes (15) at the front of the paint roller casing evenly spaced at 45mm from each other.
- Place the clear hose (12) inside the casing and tie it with 4 cable ties (14).
- Place elbow pipe (16) at each side of the clear hose.
- Cut two clear hoses with the length of 25cm.
- Fit the two clear hoses (17) at the end of the elbow pipes.
- Fit the two clear hoses (17) to a Y pipe (18).
- Tie the Y pipe with a cable tie (19).
- Fit another clear hose (20) to the end of Y pipe. The length of the clear hose depends on the length of the paint roller handle.
- The other end of the clear pipe is fit to a controller (21).
- Build the aluminium casing (22).
- Cut the black hose (23), fit it to the controller and water pump in the aluminium casing.
- Fit another black hose to the water pump (24) and paint tank (25).
- The water pump is connected to the battery (26) that is connected to a switch (27) and charger plug (28).

Research Instrument

This study is an experimental research. The first experiment involves painting two houses with the same plan with the Smart Roller and the conventional paint roller. The goal of the first experiment is to compare the amount of paint and time used by both tools to paint the same areas of the two houses. The data recorded are the amount of paint at the beginning and at the end of the job and the time needed to finish painting process. The second experiment is to acquire the number of movements for bending when preparing the paint, when refilling the paint into both containers, when dipping the sponge into the paint and stretching when applying the paint onto the wall. The amount of paint used for both tools in this second experiment is 10 liter. The data is recorded through counting the number of movements during painting activities.

RESULTS AND DISCUSSION

Several tests were made on the Smart Roller and the paint roller to prove their effectiveness. The data were analyzed and compared. The tests focused on the amount of paint used, the number of movements and the time taken by both tools to paint the same amount of area. After the tests, the areas painted for both houses measured the same, which about 189.3m².

Amount of Paint

Table 1: The amount of paint used

Method	Amount of Paint to Paint 189.3m ² of Area	Amount of Paint/Area (L/m ²)
Smart Roller	32.18 liter	0.17 L/m ²
Paint Roller	34.07 liter	018 L/m ²

Table 1 shows the amount of paint used to paint an area of 189.3m² with the Smart Roller is 32.18 liter and the conventional roller is 34.07 liter. The amount of paint needed to paint a square meter of surface over a liter for the Smart Roller was 0.17L/m² and 0.18L/m² for the conventional paint roller. This means that the Smart Roller used 0.01L or 5.56% less paint compared with the conventional paint roller to paint a square meter of area. The results showed that the Smart Roller was better than the paint roller in terms of the amount of paint used to paint the same area. This proved that the Smart Roller worked as good as or even better than the conventional paint roller. It might seem that it was only a small saving of paint. But taking a bigger amount of area to paint, the Smart Roller would save you a lot of paint and money.

Number of Movements

Table 2: Number of movements when painting

No	Movements	Smart Roller	Paint Roller
1	Bending (Paint preparation)	1	1
2	Stretching (Painting)	A lot	A lot
3	Bending (Dipping)	1	20
4	Bending (Refill paint)	0	20

In Table 2, when using Smart Roller, a painter needed to bend only once to prepare the paint. He did a lot of stretching when applying the paint onto the wall. He did not refill the paint to paint 10 litre of paint. On the other hand, the painter who used the paint roller needed to bend to prepare the paint once. He did a lot of stretching when painting. He bent 20 times to dip the paint roller into the paint in the tray. He also bent 20 times to refill the paint roller tray. Stretching for both tools during painting was not counted and stated "a lot" because it involved a lot of movements and depended on the painter styles when applying the paint onto the wall. This proved that there were a lot less movements during the painting process when using Smart Roller compared to a paint roller. Thus, it reduces the potential to get injuries by the painters who use Smart Roller.

Time

Table 3: Time to do painting

Method	Time to Paint 189.3m ² of Area	Time per Area (s/m ²)
Smart Roller	6394.55 seconds	33.78 s/m ²
Paint Roller	11730.92 seconds	61.97 s/m ²

Table 3 shows the time used to paint an area of 189.3m² by both Smart Roller and a paint roller. The painter needed 6394.55 seconds to paint the area with the Smart Roller and 11730.92 seconds with the paint roller. The amount of time needed to paint a square meter of surface for the Smart Roller was 33.78 s/ m² and 61.97s/m² for the paint roller. This showed that the Smart Roller was 28.19 seconds or 45.49% faster than the paint roller when painting a square meter of surface. The results significantly showed that house painting using Smart Roller was significantly faster than the paint roller, thus saving time and money.

CONCLUSION

This study has shown that the Smart Roller is better than the paint roller. The Smart Roller uses less amount of paint compared with a paint roller. Painters using Smart Roller also do not have to do a lot of movements compared with painting using the paint roller. The Smart Roller also reduced the time duration needed to paint compared to the conventional paint roller. By using the Smart Roller in the construction, it is for sure will save a lot amount of money in buying paint, paying painters salary and also reimbursing painters medical expenses caused by injuries. The Smart Roller is the future of painting in the construction business as it is proven to be more efficient compared to the conventional paint roller.

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