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DESIGN AND DEVELOPMENT OF SMART AUTOMATED CLOTHESLINE

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Abstract

The S.M.A.R.T Automated Clothesline is equipped with a rain sensor module innovation where individual clotheslines will be retrieved and pulled out when the system detects a change in surrounding weather. This innovation project was developed to help people stay busy and focus on daily tasks outside and prevent their clothes from getting damp from the rain. The aim of this project is the development of new and improved innovation of clothesline. This project is guided by three main objectives, which are: (i) to design and build an automated clothesline that is climate-friendly; (ii) to control the automatic suspension system using an Arduino microcontroller; and (iii) to forecast the problem using the automated clothesline in a real-world environment. The prototype model is used hardware such as Arduino UNO rain sensor module, 5v 2ways channel opto isolator relay module, 12v actuator, 12 batteries, WIFI shield for Arduino, breadboard with the help of Arduino IDE software and BLYNK . SAC showed that when it rains, the sensor will pull the clothesline down to the roof, and when it gets hot, it will be released again. SAC prototype system was successful in achieving all of its objectives after implementation. As for commercial value, SAC has a high potential to be marketed to individuals living in apartment housing areas as it offers practical added value. Prominently, the SAC enables the use of flexibility, time-saving, and an affordable price. This innovation project is beneficial for relieving people's stress and burden about managing their clothes during absence from home, ultimately allowing them to stay focused on other daily tasks

Keywords: Keyword1; Automated Clothesline; Innovative Clothesline; Sensor Clothesline

1.0 INTRODUCTION

Malaysia is a country located in the equatorial zone with a tropical climate and experiencing various climatic changes such as rain, heat and so on [1]. These days, unpredictable climates can make it difficult for individuals to dry clothes outdoors due to unpredictable weather conditions such as rainy days [2,3]. It is now increasingly dependent on information technology to increase its efficiency and support daily task [4]. Sometimes, people also often forget to lift their clothes on the clothesline when it rains.

For working people, this will be a problem to memorize due to the factor of lack of time to manage their work and daily routines. Flexibility in clothing management at the clothesline is a phenomenon that is widely experienced by most individuals in the country. However, the anxiety for those who are not at home in the day because of being in another place such as the office causes the management of clothes on the hanger to be inflexible, thus it will disrupt the focus of their daily routine.

The problem of unpredictable weather phenomena has made it difficult for individuals to do laundry as a daily chore at home [5]. Most areas in Malaysia have rainfall distribution that is difficult to predict and irregular at certain times [6]. At the same time the busyness of individuals carrying out daily tasks outside also causes clothes that are on the clothesline outside to get wet when it rains suddenly [7]. This situation has encouraged people to go to the dobby as solutions [8]. Yet, to do so in the long time can be costly in terms of energy and money [5,7]. The best alternative to solving this problem is to innovate [7,9].

Based on this phenomenon, the idea was developed to produce a suspension innovation to prevent clothes being dried outside the house exposed to rain and cause clothes to get wet when one is not at home. During the rainy season, most people have trouble drying their clothes, especially when faced with unforeseen circumstances, such as a rainy day or a sudden storm. Moreover, Malaysia is located above the equator, causing it to experience rain and humidity throughout the year. This sometimes poses a problem for people who work away from home when the clothes they wash are not dry and have an unpleasant odour. Also, it will be more difficult for the family if they do not have a helper or maid who will help with the housework.

Therefore, the aim of this study focuses on the production of an innovative product namely S.M.A.R.T Automated Clothesline (SAC). The innovation highlighted through this study is a product created to improve and develop a prototype of clothes hanger automatically by using a rain sensor module and having Arduino IDE and BLYNK software applications that can connect to the telephone reception system. The innovation project is divided into two categories, namely the user scope which focuses on individuals living in apartment dwellings, individuals busy doing daily tasks outside and the project scope which focuses on the use of Arduino IDE and BLYNK with Rain sensor module and phone for application / The innovation project is divided into two categories, namely the user scope which focuses on individuals living in apartment dwellings, individuals busy doing daily tasks outside and the project scope which focuses on the use of Arduino IDE and BLYNK with Rain sensor module and phone for applications.

2.0 LITERATURE REVIEW

Surveys play a very important role in this project, the researchers analysed existing clotheslines products on the market [10]. However, there is many shortcomings we noticed during the survey. First and foremost, some of the existing hanging products in the market such as clever close line, versaline clothesline T-Poles and umbrella clotheslines. However, these clotheslines products are products that must be operated manually by the user and have no automatic features.

Next, since the focus of this study is on apartment houses, the majority of individuals who live in them prefer to use only two types, namely clever close line and versalin clothesline. However, any traditional type suspension should be operated manually and in the event of rain, no one is in the apartment of the house. So, the clothes are easily wet, and the product will not be useful. Therefore, the researchers chose to innovate on the suspension by incorporating automated system elements which does not require manual operation, which has a rain sensor that is activated at any time of the day or night. The production of this SMART Automated Clothesline enhanced with the use of sensors to detect rainwater. The sensor used is water sensor. When the water sensor does not detect rain, the motor will rotate clockwise, and the clotheslines will be pulled out. Users will receive all notifications regarding the movement of the clothesline directly on the mobile phone.

3.0 METHODOLOGY

For this project, researchers have used the Waterfall method as the project methodology. The methodology is a systematic sequence of activities to solve a problem by developing an Arduino system in this project. The Waterfall model was adopted in this study because this model is very much in line with the objective of this study of prototype production of S.M.A.R.T Clotheslines.

The waterfall model is divided project activities into linear sequential stages, each of which is dependent on the previous phase's deliverables and corresponds to a task specialisation [11]. For certain areas of engineering design, this method is standard practise. In software development, it is typically considered to be one of the less iterative and flexible methodologies, as progress is mostly in one direction through the phases of idea, initiation, analysis, design, construction, testing, deployment, and maintenance, rather than in two directions. This concept was developed in the manufacturing and construction industries, where highly structured physical surroundings made design changes prohibitively expensive much earlier in the development process. As far as knowledge-based creative work was concerned, there were no recognised alternatives to the approach when it was originally introduced for software development [11].

The sequential dependency on the prior deliverable in Waterfall Model. A dependability which holds back system design when the analytical model is still to be signed off and holds back coding if the design is yet to be signed off [12]. A further step in Royce's disquisition examined the iterative link between subsequent development phases. Meanwhile, each development phase proceeds, and the design is progressively defined, there is an iteration with the preceding and succeeding processes, but rarely with the more remote steps.

Thus, at any stage in the design process following the requirements analysis is accomplished there exists a definite and closeup shifting baseline to which to revert in the event of unforeseen design issues [13].

The Waterfall Model adheres to a plan-driven approach. The waterfall model contains six steps that must be completed in order. This means that the next phase cannot begin until the previous phase is completed. It is divided into seven phases: (i) requirement analysis; (ii) system design; (iii) implementation; (iv) system testing; (v) system deployment; (vi) system maintenance; and (vii) testing. As a result, it is critical to recognize and understand each process that exists in the methodical structure of each phase, as each phase is distinct [14].

Phase 1: Requirement Analysis

At this stage, researchers discuss project proposals. This discussion takes into account the phenomena studied and led to the production of S.M.A.R.T Automated Clothesline.

Phase 2: System Design

System designs are available or customized according to the needs of users in the market.

Phase 3: Implementation

The system was developed in the correct order of hardware combination once it was designed. Each integrated component, such as the Arduino UNO, Servo Motor, Battery, and other components, will be checked for a feature known as Unit Testing.

Phase 4: Testing and Integration

During this phase, ensure that the system functions as intended and that no problems in the development process have occurred. This system is ready to be put to the test.

Phase 5: System deployment

When all the materials are ready to be combined in the appropriate way. This system's experiments can be done more precisely.

Phase 6: System Maintenance

Before the system is tested, component combinations can be modified during this step if one of the components fails. To maintain it up to date, maintenance is performed.

Phase 7: Testing and Evaluation

Ensure that the system can execute and that there are no code errors throughout this phase.

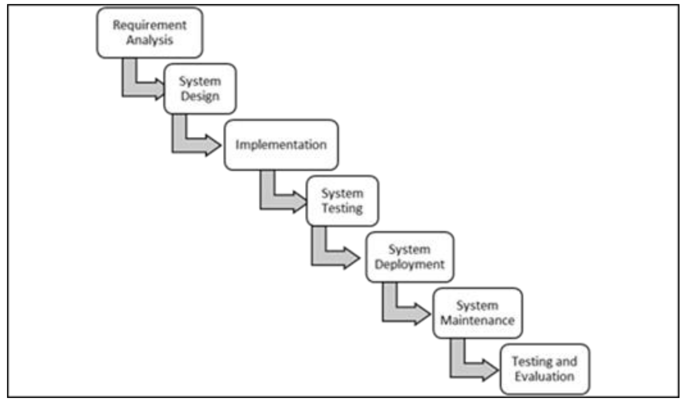

Figure 1. Waterfall Model: Adopted from Benington (1983)

4.0 REQUIREMENTS, TESTING AND RESULT

This section describes the requirements specifications. It is explained in detail, which covers an overview of functional and non -functional requirements.

Functional Requirement

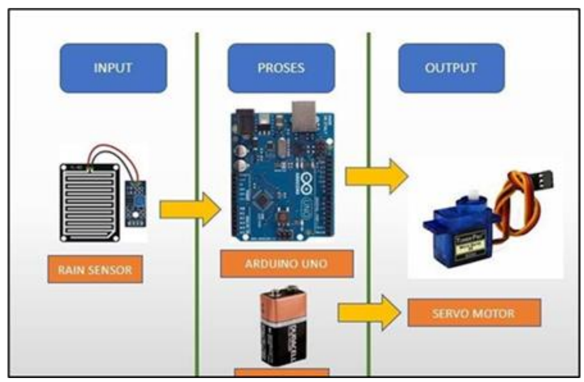

Figure 2. Functional Requirement Components

Functional Requirement defines a function in the application, where the function described as a specification of behaviour between input and output. In the system following are the functional requirements: (i) Arduino UNO; (ii) water Sensor; (iii) servo motor; and (v) jumper male-female. The Arduino Uno is an ATmega328-based microcontroller board. There are 14 digital input and output pins, 6 analogue inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button on this board. It comes with everything need to get started with the microcontroller; simply plug it into a computer with a USB wire or power it with an AC-to-DC adapter or battery. The Arduino Uno is unique in that it does not employ the FTDI USB-to-serial driver chip found on previous boards. Instead, it uses an Atmega8U2 that has been coded to act as a USB-to-serial converter. The name "Uno" comes from the Italian word "uno," which means "one." It was chosen to commemorate the imminent introduction of Arduino [15].

A rain switch, also known as a water sensor, is a switching device that is actuated by rainfall. Rain sensors have two primary applications. The first is a water-saving gadget that is attached to an automatic irrigation system and causes it to shut down if it rains. The second is a device that protects the interior of a car from rain and allows windscreen wipers to operate in automated mode. In professional satellite communications antennas, a rain blower is activated on the antenna feed aperture to remove water droplets from the Mylar cover that keeps pressurised and dry air inside the waveguides [16].

A servo motor is a type of motor that has a high degree of precision in rotation. Servo motors often have a control circuit that provides feedback on the current position of the motor shaft; this feedback allows them to rotate with great precision. A servo motor is used when for spin an object at a specified angle or distance. It consists of nothing more than a simple motor connected to a servo mechanism. A DC servo motor is one that is powered by a DC power supply, whereas an AC servo motor is one that is powered by an AC power supply. For the sake of this tutorial, we shall simply discuss the operation of a DC servo motor [17].

There are many more varieties of servo motors based on the type of gear arrangement and operating characteristics in addition to these primary classifications. A gear arrangement on a servo motor allows us to produce a very high torque servo motor in a tiny and lightweight package. They are employed in a variety of applications, including toy cars, RC helicopters and planes, robotics, and so on, because to their characteristics. Male-to-male, male-to-female, and female-to-female jumper wires are the most common. The distinction between them lies in the wire's terminating point. Male ends have a protruding pin and can be plugged into items, but female ends do not have a projecting pin and are used to plug into things. Male-to-male jumper wires are the most frequent and the ones most likely need. A male-to-male wire is required for connecting two ports on a breadboard.

Non-Functional Requirement

The software system's performance requirements are constrained. Static and dynamic performance requirements are the two types of performance requirements. The execution of static is not constrained by the number of terminals or simultaneous users. The next step is to specify dynamic limits on the execution behaviour, which are usually based on response time.

This construction of an Automatic Clothesline necessitates the use of Arduino to create coding to control the system. When building an autonomous and controllable cloths line system, the first step is to discuss the project title with the supervisor, who will then create the presentation after the proposal is completed. The project sketch was then produced to ensure that no errors occurred throughout the development of the autonomous and controllable cloths line system.

The next step is to purchase the essential components for the project, including the Arduino UNO, Servo motor, GSM, Jumper (male-to-male, female-to-male, and male-to-male), 9V batteries, and other appropriate goods. Simultaneously, coding searches pertinent to this project were implemented in order to boost the system's development.

All of the components are connected according to the diagram. The Arduino UNO is then linked to the laptop to guarantee that the coding is free of errors when the user tests it. Following component maintenance, all components are properly connected and functional, and the components are positioned in the frame in the suitable location. This technology is also checked to ensure that no problems arise.

Finally, when the rain drops, the detector may detect the automatic roofing of the roof, and the user can give the system instructions through message to move the system out or into the housing area, indicating that the system was successfully built.

Prototype Testing

Unit testing is a type of software testing that examines each individual unit or component of a programme. Here are the results of the testing conducted for this prototype:

Figure 3. Prototype

Table 1. Testing Result

Test Case Name	Test Procedure	Precondition	Expected Result	Result
Rain Sensor	Arduino software is needed to help the rain detector work properly	Ensuring rain sensors can detect rain	Rain sensor successful detect rain	Pass
Servo Motor	Arduino software is needed to help the servo motor work properly	Ensures servo motor works perfectly	Servo motor will move after detect rain	Pass
User	Arduino software is needed to help the rain detector work properly	None	Users can command the system from Arduino Software	Pass

4.0 CONCLUSION

In brief, the testing results show all good and functional results for the SMART Automated Clothesline prototype produced in this study. This SMART Automated Clothesline also has some advantages that can be gained from this project which will of course solve the problems that have been stated on the problem statement. The advantage of this project is that it can reduce the burden of users for example when the clothesline moves automatically under the roof and users of this system do not have to take off their clothes when it rains. The goal of this study has also been achieved which is to design and build an automated clothesline that is climate friendly. Next, to control the automatic suspension system using an Arduino microcontroller. Also, to forecast the problem using the automated clothesline in a real-world environment. This product has the potential to be commercialized in the local market.

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