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|  | MINISTRY OF EDUCATION AND TRAINING |

FPT UNIVERSITY

Capstone Project Document

**DESIGN AND CONSTRUCTION SUN DRYING WET CLOTHES SYSTEM**

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| **Ext. Supervisor** | **N/A** |
| **Capstone Project code** | **DCDCS** |

-Ho Chi Minh City, **June 26th 2018**

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# Definitions, Acronyms and Abbreviations

|  |  |
| --- | --- |
| Name | Definition |

# Introduction

## Project Information

* **Project name:** DESIGN AND CONSTRUCTION SUN DRYING WET CLOTHES SYSTEM
* **Project Code:** DCDCS
* **Product Type:** Embedded Device, Android Application, RESTful Web Service
* **Start Date:** 14/06/2018
* **End Date:** 31/08/2018

## Introduction

In this document, we introduce a solution for automatic clothes drying system. We build a system, which use rain sensor to detect rain, ESP8266 for communication between Android application and embedded device.

This document also describes our working process in 4 months includes our perspective in the system, component designs and detailed core workflows. We hope the system will help resolve some aspects of the problem that the current face recognition systems are facing today.

## Current Situation

Vietnam is a rainy country, with 6 months of sunshine and 6 months of rainy. Vietnamese people prefer drying their clothes under sunshine, wind over using clothes dryer or another dryer machines. When the rainy season comes, Vietnamese people tend to worry about their clothes at home being wet by rains. There are a few solutions to solve this problem as known as “Smart Clothesline Rigs”. This device really expensive and not really that smart. With 13.000.000 VND, you can have controllable system with UV light, build-in dryer and remote control within 30 meters. However, this system is not really solve the core problem: Automatically collecting clothes. Therefore, we come to this solution, helping Vietnamese people not to worry about their clothes during rainy season.

## Problem Definition

With systems currently available on market

Advantage of their system:

* UV disinfection
* Built-in dryer
* Strong structure can lift up to 25kg of clothes
* Below are disadvantages of current situation:
* Current systems have high production costs
* Hard to extend
* Control manually when the electricity is down
* Cannot automatically collecting clothes when rain

## Proposed Solution

Our proposed solution is designing and construction automatic clothes drying system called DCDCS to solve missing feature of current “Smart Clothesline Rigs”. Our system will help users automatically collect clothes when it is a rain. It is much cheaper, easy to install and mobile and extendable.

DCDCS system includes a mobile app and an embedded device with following functions:

### Feature Functions

* **Mobile App:**
  + Control the system through wireless
  + Check weather information
  + Check system status
* **Embedded Device:**
  + Check system status
  + Control system through hard buttons

### Advantages and Disadvantages

* **Advantages:**
  + Low costs
  + Can detect rain very fast
  + Can control with mobile app
  + Use solar energy and have battery to storage unused energy
* **Disadvantages:**
  + Cannot detect whether the clothes is dry or not
  + Cannot detect whether rain is over or not

## Functional Requirements

Functional requirements of the system are listed as below:

* Embedded system component:
  + RESTful API communication through wireless
* Use Arduino Mega 2560 as a central circuit unit
* Show information about the system
* Time
* Temperature
* Humidity
* Control dryer
* Control clothesline
* Power supply component:
* Power supply operates for the entire system
* Distributed voltage 5V and 12V
* Auto charging
* Storing energy
* User component:
* Control the system from Android application through wireless
* Turning on/off build-in dryer
* Set timer for dryer
* Control the clothesline
* Check system status and weather
* Edit user information
* Name
* Address
* Mobile phone
* Etc
* Mobile Application component:
* Communicate with system through wireless and by REST API
* Show information about the system
* Time
* Temperature
* Humidity
* Weather (Rain or not)
* System status

## Role and Responsibility

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Full name | Role | Position | Contact |
| 1 | Nguyễn Đức Lợi | Project Manager | Supervisor | loinnd@fpt.edu.vn |
| 2 | Hoàng Phi Long | Developer | Leader | longhpse62021@fpt.edu.vn |
| 3 | Nguyễn Đình Phong | Developer | Member | phongndse@fpt.edu.vn |
| 4 | Trịnh Bình | Developer | Member | binhtse@fpt.edu.vn |

Table 1: General Roles and Responsibilities of Member

## Conclusion

* Research to determine and implement the appropriate MCU for the Central Control Unit and other nodes
* Design and implement integrate PCB board.
* Research and implement NoSQL Database, RESTful API, Mobile Application.
* C, C++ embedded into Arduino.
* Use software in design PCB, Schematic such as OrCAD, Proteus
* Communication technique: TCP, HTTP

# Software Project Management Plan

## Problem Definition

### Name of this Capstone project

* Official name: Design and construction sun drying wet clothes system
* Vietnamese name: Thiết kế và xây dựng hệ thống phơi đồ tự động
* Abbreviation: DCDCS

### Problem Abstract

Vietnamese people work all day long. They spend time at evening and night to do their housework. One of the housework that is washing clothes then drying them. However, Vietnam is a rainy country. During rain season, everybody very worry about their drying clothes at home getting wet.

### Project Overview

#### Current Situation

Below are the problems encountered in the project:

* **Hard to improve the system:** Our system is a very simple system. However, to improve the system is a hard mission. Our system currently cannot detect when the clothes are dry, when the rain is stopped for auto collecting clothes or continue drying wet clothes. To do so, it requires mathematics model called Hidden Markov Models. However, due to the lack of knowledge in statistics and linear algebra; we are currently unable to implement this model.
* **Lack of knowledge in telecommunication:** While using ESP8266, we found out that there are some interferences during transmission. Without telecommunication, we do have hard time to detect the problem.

#### The Purposed System

According to the technology researches, we found that the simple rain sensor and ESP8266 Wifi module is capable in solving the problem. We can use rain sensor detect raining and ESP8266 for wireless communication.

We assign task responsibility vertically to make sure if any member in this project fail in our team, harm would be minimized for the project.

We also build a mobile application for real-time demonstration.

#### The Boundaries of the system

Our system provides these functions:

* Automatically control clothesline when there is a rain or at night.
* Dryer system so that user can dry their clothes on rainy days
* Control system via RF Remote control
* Control system via Button on the system
* Check system status and control system via Mobile application

#### Future plans

* Implement Hidden Markov Models (HMM) for rain forecasting
* Implement the system can determine when the rain has stopped using HMM
* Build a website for user to check their account information and control the system along with mobile application
* Build a system that can detect whenever the clothes is dry or wet

#### Development Environments

##### Hardware Development Environment Requirement

For CCU clothes drying system

|  |  |
| --- | --- |
| Component | Hardware |
| Mainboard | Arduino Mega 2560 |
| Communication | Wire and cable |
| Devices | - Module real-time clock DS1307  - Rain sensor  - Humidity and Temperature sensor DHT11  - Light sensor BH1750  - DC Motor  - Nokia 5110 LCD  - 4x4 Matrix keypad  - Limit switches  - Solar Panel  - Battery  - … |
| Power source | 5V – 12V |
| Android Device | Any android mobile phone has 3G/4G or Wifi connection |

Table 2: Hardware development environment requirement for DCDCS System

##### Software Development Environment Requirement

|  |  |
| --- | --- |
| Software | Name / Version |
| Operating System | Windows 7 or above |
| Environment/Run-time | Adruino Mega 2560  NodeJS |
| Modeling tool | Draw.io for UML  Proteus 8 for PCB Board |
| IDE | Visual Studio Code  Arduino IDE |
| DBMS | MongoDB |
| Source control | Git-scm and Github |
| Communication tools | Facebook Messenger  Gmail |

Table 3: Software development environment requirement for DCDCS System

## Project Organization

### Software Process Model

This project is developed using modified waterfall model. We apply modified waterfall model because it suitable with current situation in our team. We choose this model because of the following reasons:

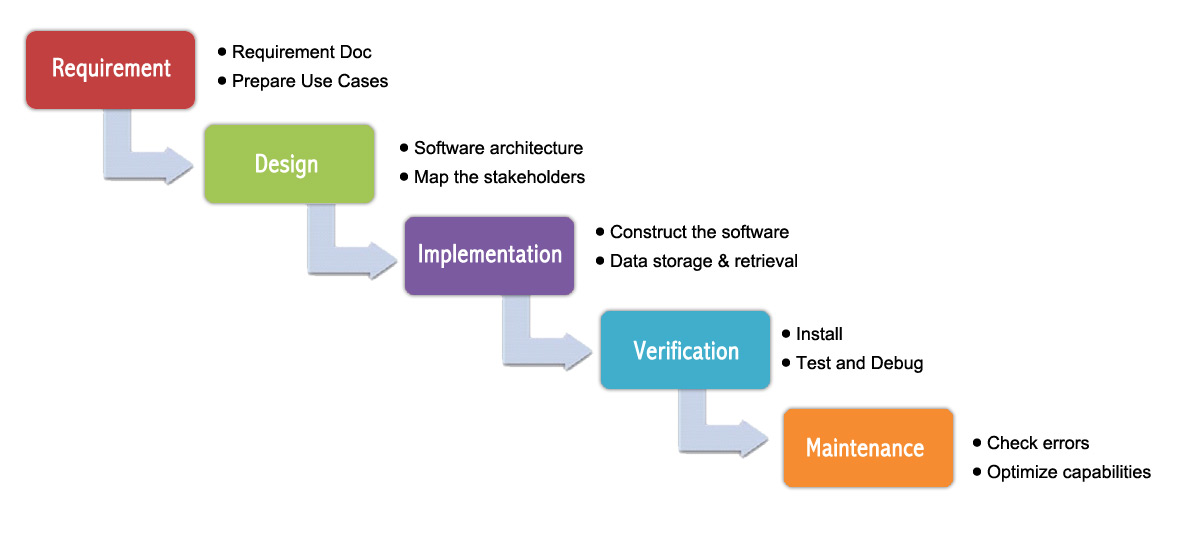
* This project is 4-months long due to the FPT University Capstone Project timeline, which can be consider a short project.
* Based on researches and current clarified face recognition system, the requirements of this project are stable, clear, fixed and well-understood by all team members.
* The Modified Waterfall Model involves verification and validation between the phases, so any deviations can be corrected immediately, providing the customer satisfaction, so this is preferred.

Figure 1: Waterfall methodology

### Roles and Responsibility

|  |  |  |  |
| --- | --- | --- | --- |
| No | Fullname | Role | Responsibilities |
| 1 | Nguyễn Đức Lợi | Supervisor, Project Manager | * Specify user requirement * Advisor for ideas and solutions * Give out techniques and business analysis support |
| 2 | Hoàng Phi Long | Team leader, developer, tester | * Managing process * Dividing tasks for team member * Create test plan * Clarifying requirements * Coding * Testing * Verify document * Managing budget * Database design |
| 3 | Nguyễn Đình Phong | Team member, developer, tester | * Create test plan * Database design * Clarifying requirements * Prepare document * Coding * Testing * GUI Design |
| 4 | Trịnh Bình | Team member, developer, tester | * Create test plan * GUI Design * Database design * Clarifying requirements * Prepare document * Coding * Testing |

Table 4: Roles and responsibilities

### Tools and Techniques

|  |  |
| --- | --- |
| Tools | |
| Developing tools | Visual Studio Code  Arduino IDE |
| Database system management | MongoDB |
| Source Control | Git-scm and Github |
| Models and Diagrams tool | Draw.io |
| Techniques | |
| Embedded System | C/C++ , Arduino SDK |
| Web Service System | ExpressJS & NodeJS |
| Mobile Application | React Native, Javascript |

Table 5: Tools and techniques

## Project Management Plan

### System Development Life-cycle

Below are all the major tasks that need to be performed sequentially during the development of the system.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Description | Deliverables | Resource needed | Dependencies and Constraints | Risks |
| Requirement Analysis | - Identify and clarify main functions.  - Prepare task plan.  - Research mechanics of collecting clothes system  - Research solar energy circuit | - Report No. 1 Introduction.  - Project Management Plan  - Task sheet  - Prototypes | 14 man-days | N/A | - Missing requirement.  - Unclear project’s scope.  - Lack of member share of understand. |
| Design | - Identify hardware and software requirements.  - Decide software architecture.  - GUI design using top-down break down.  - Design database. | - Report No. 2 Software Project Management Plan.  - Report No. 3 Software Requirement Specification.  - Report No. 4 Software Design Description. | 20 man-days | Depend on “Requirement Analysis”. | - Misunderstood or unclear system’s requirement.  - Lack of practical experience leading to unreasonable design. |
| Implementation | - Collect temperature, humidity datasets.  - Build hardware system  - Implement embedded software system  - Implement Android GUI.  - Build REST API | - Demonstration application.  - Report No.5 System Implementation & Test. | 50 man-days | Depend on “Design”. | - Lack of practical experience and knowledge.  - Human mistake.  - Broken hardwares due to wrong implementation  - Interference signal while ESP8266 communicate with Http Protocal |
| Testing | - Prepare test plan and test case.  - Test all functions and results. | Report No.5 System Implementation & Test. | 20 man-days | Depend on “Implementation”. | - Lack of experience.  - Not enough time for performing test.  - Missing bugs.  - Human resource. |
| Maintenance | - Deploy the system.  - Create the user’s manuals. | Report No.6 Software User’s Manual. | 10 man-days | Depend on “Testing”. | - Lack of experience and knowledge.  - Human mistake.  - User’s manual may be difficult for user to understand and confuse. |

Table 6: Project task planning

### Plan Detail

#### Phrase 1: Requirement Analysis

|  |  |  |
| --- | --- | --- |
| Task | Description | Author |
| 1. Research mechanics of collecting clothes system | - Research on current systems, their strengths and weakness. | Hoàng Phi Long  Nguyễn Đình Phong |
| 1. Research solar energy | - Research on current systems, their strengths and weakness.  - Research how to convert solar to electricity and charge into batter | Nguyễn Đình Phong  Trịnh Bình |
| 3. Identify and clarify main functions | Define main and needed functions the system must include. | Hoàng Phi Long  Nguyễn Đình Phong  Trịnh Bình |
| 4. Create system introduction | Complete Introduction Report. | Hoàng Phi Long |
| 5. Software Project Management Plan | Prepare Project Management Plan. | Hoàng Phi Long |
| 6. Prototype | Build a prototype of system and mobile application. | Nguyễn Đình Phong  Trịnh Bình |
| 7. SRS | Create SRS document. | Hoàng Phi Long  Nguyễn Đình Phong  Trịnh Bình |

Table 7: Plain Detail - Requirement Analysis

# 

# Software & Hardware Requirement Specification

# Software & Hardware Design Description

# System Implementation & Testing

# Software & Hardware User’s Manual

# Acknowledgement

# Reference