SOFTWARE DEVELOPMENT PLAN

FOR THE

DC MOTOR SPEED CONTROLLER

10/04/2019

Not Approved For Public Release; Distribution Is Limited

## RECORD OF CHANGES

\***A-** ADDED **M**-MODIFIED **D**-DELETED

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **VERSION NUMBER** | **DATE** | **NUMBER OF FIGURE, TABLE, OR PARAGRAPH** | **A \***  **M**  **D** | **TITLE OR BRIEF DESCRIPTION** | **Change Request Number** |
| 1 | 10/05/2019 |  |  | Initial Revision |  |

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# PROJECT SCOPE

This Software Development Plan (SDP) establishes the plan for software implementation and test for a DC Motor Speed Controller. The DC Motor Speed Controller is being developed under the direction of the Embedded Software Companies from Queretaro committee. Updates to this SDP will address future upgrades to the DC Motor Speed Controller.

## Document Overview

This SDP identifies applicable policies, requirements, and standards for the DC Motor Speed Controller software development. It defines schedules, organization, resources, and processes to be followed for all software activities necessary to accomplish the development.

## System Overview

The DC Motor Speed Controller involves the development of an embedded software application using the Renesas S7G2 Starter Kit SK R7FS7G27H3A01CFC and Renesas e2 studio (Eclipse based). This application shall control the speed of a DC motor with a squared signal input at a constant frequency.

The PWM frequency shall be in between a range of 100 Hz to 1 KHz. Once the PWM frequency is selected, this shall be constant, only the “duty cycle” will be modifiable.

A Hall-effect sensor will be placed at the shaft of the DC motor to measure the speed of the motor by counting the amount of pulses to achieve one full spin.

The higher the speed of the motor, the higher will be the amount of pulses from the hall-effect sensor, and vice versa.

The motor shall regulate the speed to the value set by the user.

Additionally, an LCD shall display the motor speed and the Set Point (both in RPM’s), as well as the percentage of the PWM duty cycle value.

## Referenced Documents

The documents listed below were either used to create this document or are referenced in it:

1. Software Requirements Document included in the <Project\_Path>\1)Requirements\SWRA.docx
2. Renesas S7G2 Datasheet

# Overview of required work

|  |  |  |  |
| --- | --- | --- | --- |
| Program Strategy | Define All Requirements First? | Multiple Development Cycles | Field iterim Softwarwe? |
| Grand Design | Yes | No | No |
| Incremental (Preplanned Product Improvement) | Yes | Yes | Maybe |
| Evolutionary | No | Yes | Yes |

Table 1. Key Features of Three DoD Program Strategies

Selected methodology is the Incremental Program Strategy (Preplanned Product Improvement).

The DC Motor Speed Controller will apply and Incremental (Preplanned Product Improvement) strategy to develop and evolve the functional capabilities of the System Software. In this program strategy the requirements are defined and then the development of the software consists on a sequence of builds. Each sequence of builds adds more capabilities until the system is complete.

All issues concerning cost, schedule, and incremental build content must be negotiated with the Project Manager.

# DELIVERABLES

## Change control

The change control types that will be driven in the Project will be:

* Change Request
* PR

The Change Control Process is defined in the Figure X.

Ilustración 1. Proceso de control de cambios

## Source Control for Deliverables

GIT will be used for Data Configuration Management and Product Configuration Management. Development, Engineer, and Production releases will be managed through the GITHub environment. (See Figure 2)

The Development builds will be delivered through a branch called *Develop* integrated in a Main Branch called Master.

The Engineer builds will be delivered through a branch called *Eng* integrated in a Main Branch called Master.

The Production build will be delivered through a branch called *Prod* integrated in a Main Branch called Master.

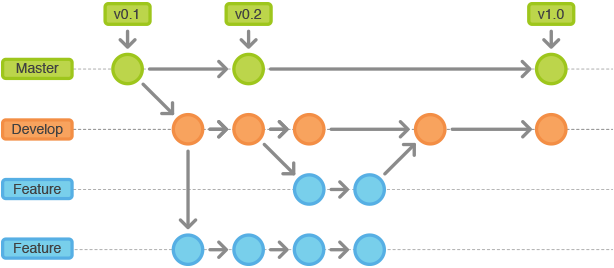


Ilustración 2. Workflow Cycle of Git. <https://leanpub.com/>

## Supplies

* RENESAS Development Board Model S7G2 SK R7FS7G27H3A01CFC.
* Display LCD 320X240, 2.4”
* CESEQ\_P001
* CESEQ\_C001

## Infraestructure

* Test Bench
* PC
* Wireless Network (Wi-Fi) or wired network (Ethernet).

### Hardware

* Scope
* Multimeter
* Power Supply
* Tachometer

### Software

* Renesas e2 studio (Eclipse based)
* GCCARM Compiler
* GIT
* Microsoft Office 2010

# DEVELOPMENT METHODOLOGY

The DC Motor Speed Controller development will apply the following general methods:

1. The project will follow the defined processes documented in the SDP to conduct software requirements analysis and manage the Software Requirement Specification (SRS) Document. Express software requirements in a language that addresses an objective per statement and promotes measurable verification.
2. The project will adhere to the standards required by the SDP for design, coding and test methods for the development of the software.
3. The Software Development Group and the Software Test and Evaluation Group collaborate during software requirements analysis and then proceed with separate activities that are intended to ensure the software complies with the detailed software requirement specification.

## Standards for Software Products

The DC Motor Speed Controller software development will comply with the documents listed in Table X. these documents impose standards that are applicable to software requirements, design, coding, testing, and data.

Para optimizar los tiempos de entrega, predecir riesgos, y solucionar problemas a lo largo del proyecto se deberá usar la metodología SCRUM.

Los viernes y sábados por la tarde se deberá llevar a cabo una junta de SCRUM en el que los participantes puedan compartir su progreso de sus actividades asignadas y si tienen alguna dependencia o *roadblock* que les impida terminar en el tiempo acordado.

Los sprints se deberán llevar a cabo cada dos semanas en donde se revisarán las distintas liberaciones.

# ESTIMATES

# PLANNING

This SDP shall be maintained and modified to reflect the current plans, policies, processes, resources, and standards affecting the DC Motor Speed Controller Project.

Microsoft Excel will be used to develop and maintain the DC Motor Speed Controller Project master plan and schedule using a Gantt Diagram as defined in Figure X.

## Roles and Responsibilities

The roles and responsibilities for the project are listed below.

1. Project Manager will maintain the master plan and schedule updated along with the Data Configuration Management and the Product Configuration Management.
2. Software Requirements Team manages the requirements data base
3. Software Development Group performs analysis to identify algorithms, high level data flow, interfaces and logical functions, and performs updates in response to PRs
4. Software Design Team performs analysis to create the functional model and design of the software system
5. Software Test and Evaluation Group performs analysis to implement the test case and test procedures defined, plans, integrates, and execute tests.

## Gannt Diagram

The Master Schedule is stablished as defined in the Figure X.

Add here Gannt Diagram with the master schedule

# Solving Problem Strategy

# Design

## Standards

## Naming Conventions

# Testing

The purpose of testing is to incrementally integrate the software builds into larger software components, and components into a complete system. Testing is performed to validate each component’s ability to meet its stated requirements and to ensure the operability of the final software component.

Integration continues until all software components are integrated with the system-level hardware into a single functioning system.

## Verification strategy (BlackBox Test)

## WhiteBox Strategy

## Cyclomatic Complexity Redundance Index

# RELEASE

The Software Release Files are organized as defined below:

1. Development – Used for internal software releases.
2. Engineering – Used to be implemented, verified and validated in the hardware.
3. Production – Official release to the client

The development and engineering releases will follow the format of Year\_Week\_Version\_Iteration

Development Release Files will be uploaded to the GIT Dev Branch each week with the following documents:

* C Code File .c , .h

Engineering Release Files will be uploaded to GIT Eng Branch each week with the following documents:

* Executable File .exe

The Production Release Files will be uploaded to GIT on October 26, 2019 with the following documents:

* Executable File .exe
* Calibration and Testing Document .docx
* Microcontroller Configuration File .docx

## Software Development Folder

## Integration Test Strategy

## Validation Testing / Functional Testing

## Throughput and Flash and RAM measurement

# Results

# Lessons Learned