

# **FIREBOT SOFTWARE**

CS 350 SOFTWARE ENGINEERING II

SPRING 2018 PROJECT

ALI KALKANDELEN

SAMUEL OWUSU-BINEY

## **"Firebot" Fire Extinguishing Robot**

There are more than 20,000 house fires and more than a dozen wildfires in the United States each year. Most of the time these fires are not immediately controlled or rescued due to lack of resources and personnel.

The firebot is a fire-extinguishing robot designed to assist firefighters in times of wildly spreading, uncontrollable fires, where seconds and minutes will make the difference between life and death. Firebot will be a self-sufficient, portable, powerful robot able to fight even the highest of blazes.

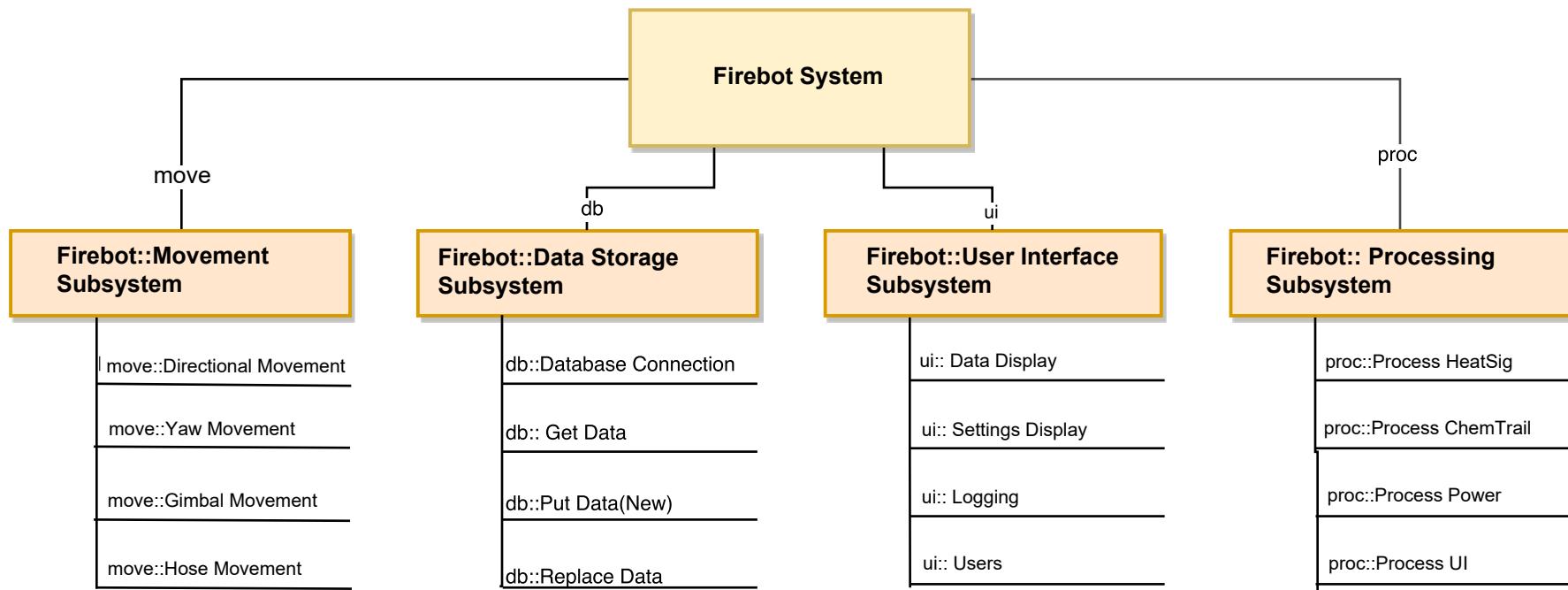
The robot will essentially be a water or foam tank attached to a rover along with a hose to spread the liquid evenly among the fire. The water or foam will depend on the situation and will easily be able to get filled through the firetruck or hydrant. The hose will be special stainless steel pipe with a custom tip that can change the spread of the solvent as appropriate for the situation.

The robot will detect the fire using changes in heat signatures on its high field of view camera. The camera will also detect high concentrations of carbon dioxide, which is a common molecule found in almost all fires. Once detected the robot will engage the fire using its reserve and hose as necessary and calculate the best angle and procedure for the extinguishing method.

## **Stake Holders**

- **Government**
- **Fire Departments**
- **Municipalities**
- **Rescue Teams**
- **Non-Profit Organizations**

## 5. Draw The Block Diagram, identify Subsystems and methods



# 6 - Interfaces

| <u>Movement</u>   |                  |                   |
|-------------------|------------------|-------------------|
| <u>Field Name</u> | <u>Data Type</u> | <u>Data Shape</u> |
| Yaw               | Int              | xxx.xxx           |
| Pitch             | Int              | xxx.xxx           |
| Roll              | Int              | xxx.xxx           |
| Speed             | Int              | xxx.xxx           |
| Wheel_RPM         | Int              | xxx.xxx           |
| Hose_Speed        | int              | xxx.xxx           |
| Robot_Turn        | int              | xxx.xxx           |
|                   |                  |                   |
| <u>DB</u>         |                  |                   |
| dataID            | int              | xxx               |
| dataName          | varchar          | xxxx xxxx         |
| heatSigVal        | int              | xxx xxx xxx       |
| userID            | varchar          | xxxxxx            |
| userName          | varchar          | xxxxxx            |
| userPhone         | varchar          | XXX-XXx-XXX       |
| userRegion        | varchar          | xxxxxx            |
| connectionID      | int              | xxxxxx            |
|                   |                  |                   |
| <u>UI</u>         |                  |                   |
| menuID            | int              | xxx               |
| menuName          | varchar          | XXXX              |
| batteryLvl        | int              | xxxx              |
| hoseAngle         | int              | xx.xxxx           |
| statusID          | int              | xx.xxxx           |
| statusName        | varchar          | xxx               |
| emergencyStopTrig | int              | x                 |
|                   |                  |                   |
| <u>Process</u>    |                  |                   |
| settingID         | Int              | xxx               |
| settingName       | varchar          | xxx               |
| radiusCalc        | int              | xxx               |
| chemToHeatFactor  | int              | xxx               |

## 7 – Functional Requirements

- **The Database:** Store Data such as:
  - User information such as name, address, position
  - Robot Locational and Movement Data
  - Data about current and past actions
  - Logs
- **Front-End Framework:**
  - Display the webpages, buttons, forms, etc..
  - Display the Graphics and Reports it receives from back-end.
  - Create functionality for all the intractable UI.
- **Back-End Framework:**
  - Crawl through external webpages, polls, news articles, google searches, databases, etc. to pull out data relevant to the area searched.
  - Make judgements based on all the data received. Use mathematical algorithms to determine hot topics and flashes. Categorize data effectively.
  - Connect to the Database to store and collect data.
- **External Login System:**
  - Handle Username/Password data.
  - Authenticate data entered and show error messages
  - Authenticate Person Position, Authority.
  - Handle changes to members.

# 8 – Non-Functional Requirements

- **Performance:** The robot will run on a 4000maH lithium Iode battery that will last about half an hour. The battery will be easily replaced. The directional speed of the robot will max out at 15 mph and a rotational speed of 15rpm. The instruction(system) to action speed is about 1/60 s.
- **Reliability:** Since the system is directly connected to the robot a reliability of 99% can be achieved. Maintenance on the caching system plugins will need to be performed once every 3 months.
- **Capacity:** The robot will be equipped with a 20 liter tank for either water or fire fighting foam. The tank will be easily refillable through a firetruck or a hydrant. The software will need to be installed individually to each robot.
- **Security:** Since the robot is used under very specific circumstances, with a supervision of at least 1 officer, security systems will not be put into place for the software. But the user will need to be authenticated and verified before the software is initiated and ultimately robot is used.
- **Portability:** A copy of the software will need to be in each robot individually and not be tampered with or installed without the consent of a professional technician. The robot will be easily portable due to its ability to move and the petite size to fit into trucks and beds.

## 9- Select a Process Model

Pick: Agile-EP

### About Agile:

Agile is mostly described as an iterative waterfall model. This is because the software is delivered in iterations as opposed to delivering it as a whole. Software is developed in Sprints that last from 1 week to 4 weeks, and then presented and evaluated with the client before proceeding to the next sprint. This way, the changes or errors in development can be done much earlier, saving a lot of money from post-delivery maintenance.



### Why choose Agile for Project:

- Made mostly for small groups working in a tight environment on a single project.
- Extreme Programming allows building a software without knowing what the client wants.
- Less prone to errors and bugs after delivery important when time and effort after delivery is not possible.

# 10 – SAFETY CONCERNS

**Safety Concern #1:** Software Compromised

Implications:

- Hacker can access database from an external network
- Hacker can add and delete data from database including entire table
- Hacker can steal user sensitive information such as full name and address.

Defense:

- Symmetric Database Encryption
- Hashing sensitive data
- Transparent Data Encryption

**Safety Concern #2:** Radio Signal Compromised

Implications:

- Wrong information is provided to the user
- Hacker can disrupt the communication between robot and operator

Defense:

- Create proper Firewall protocols.
- Encrypt Signals before being sent out
- Monitor signal disruptions

**Safety Concern #3:** Robot gets too close to fire

Implications:

- The metal can melt releasing lead into the air
- The Pressurized tank inside of robot can burst
- The battery can explode

Defense:

- Explosion proof casing of the battery and water tank.
- Calculating distance to heat signature and alerting if too low.

# 10. Project Management Plan

## 1 Overview.

### 1.1 Project Summary.

**1.1.1 Purpose, Scope, and Objectives.** The objective of this project is to develop a software product that will dictate the movements and actions of a robot that is made to extinguish fires.

**1.1.2 Assumptions and Constraints.** Constraints include the following:

The deadline must be met.

The budget constraint must be met

The product must be reliable.

The product must be able to work in harsh environments.

The product must be user-friendly.

### 1.1.3 Project Deliverables.

The complete software part of the robot, including the user manual, will be delivered 9 weeks after the project commences.

**1.1.4 Schedule and Budget Summary.** The duration, personnel requirements, and budget of each workflow are as follows:

Requirements workflow (1 week, two team members, \$5550)

Analysis workflow (2 weeks, two team members, \$9480)

Design workflow (2 weeks, two team members, \$9480)

Implementation workflow (3 weeks, three team members, \$26,830)

Testing workflow (2 weeks, three team members, \$23,220)

The total development time is 70 days and the total internal cost is \$121,310.

**1.2 Evolution of the Project Management Plan.** All changes in the project management plan must be agreed to by Ali Kalkandelen before they are implemented. All changes should be documented to keep the project management plan correct and up to date.

**2 Reference Materials.** All artifacts will conform to the company's programming, documentation, and testing standards.

**3 Definitions and Acronyms.** MSG—FireBot is a clever acronym for an awesome Fire-Extinguishing Robot

## 4 Project Organization.

**4.1 External Interfaces.** All the work on this project will be performed by Ali Kalkandelen, Samuel Owusu-Biney, and Hugh Mungus. Ali will meet weekly with the client to report progress and discuss possible changes and modifications.

**4.2 Internal Structure.** The development team consists of Ali Kalkandelen (owner) and Samuel Owusu-Biney(bff)

**4.3 Roles and Responsibilities .** Hugh and Sam will perform the design workflow while Ali talks to the clients and writes down the requirements. Then Ali and Sam will get to work with their awesome coding skills and code out the software and construct all the methods and testing code. Hugh will occasionally bring them coffee or a bottle of coke. Each member is responsible for the quality of the artifacts. Ali will oversee integration and the overall quality of the software product and will liaise with the client.

## 5 Managerial Process Plans.

### 5.1 Start-up Plan.

**5.1.1 Estimation Plan.** As previously stated, the total development time is estimated to be 9 weeks and the total internal cost to be \$121,310. These figures were obtained by changing the numbers of the previous appendix and does not include all beverage and meal plans.

**5.1.2 Staffing Plan.** All three personnel is needed for the duration of the project. Project Maintenance and decommissioning will be done by Ali Kalkandelen.

**5.1.3 Resource Acquisition Plan.** All necessary hardware, software, and CASE tools for the project are already available. The product will be delivered to the Robotics Association of New Jersey who will integrate the software into the robot.

**5.1.4 Project Staff Training Plan.** No additional staff training is needed for this project.

### 5.2 Work Plan.

#### 5.2.1–2 Work Activities and Schedule Allocation.

Week 1. Meet with client, and determine requirements artifacts. Go over each artifact and get in a heated discussion about what the customer really wants.

Weeks 2, 3. Produce and go over each analysis artifact. Show artifacts to client and spend the next couple of days showing them why certain artifacts cannot be done. Produced software project management plan(like this one), and inspected software project management plan.

Weeks 4, 5. Produce and inspect the design artifacts.

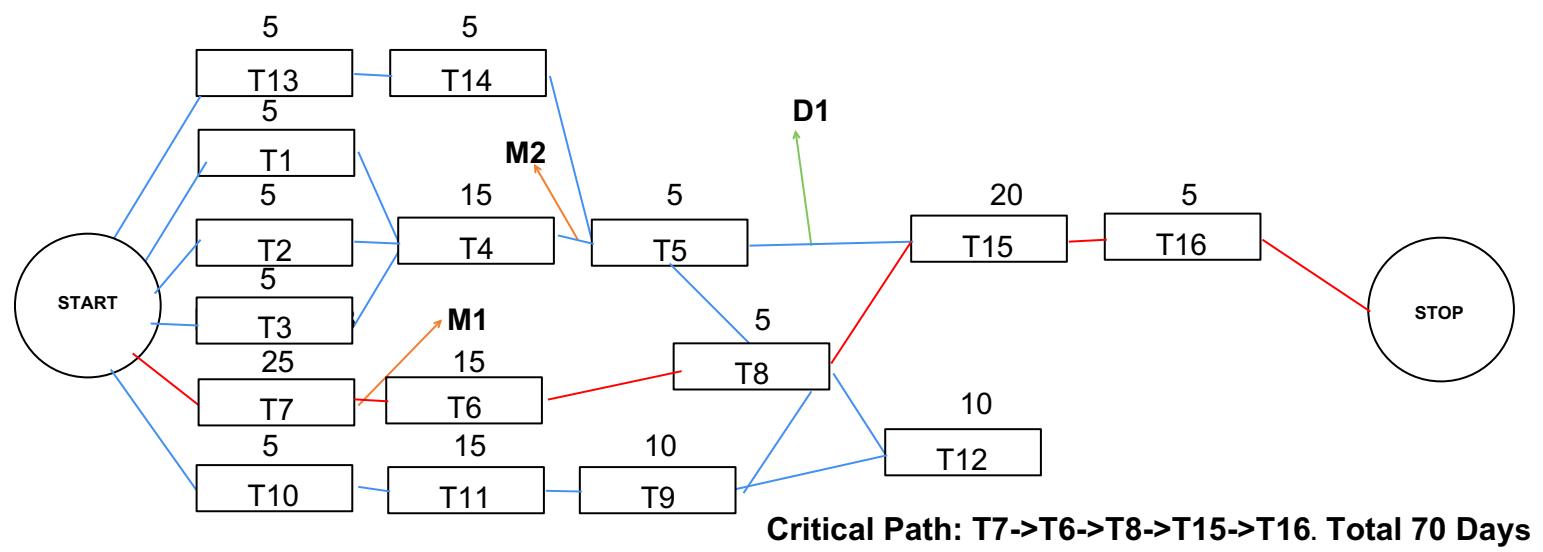
Weeks 6–10. Implementation and inspection of each class(methods), unit testing and documentation, Googling why your code doesn't work, half fixing your bugs and calling it good enough, integration of each class, integration testing, product testing, and documentation inspection.

**5.2.3 Resource Allocation.** The three team members will work separately on their assigned artifacts. Ali's assigned role will be to manage everyone else's work and critique on what they are doing right and wrong. Samuel will ensure that schedule and budget requirements are met. Risk management will also be Samuel's responsibility.

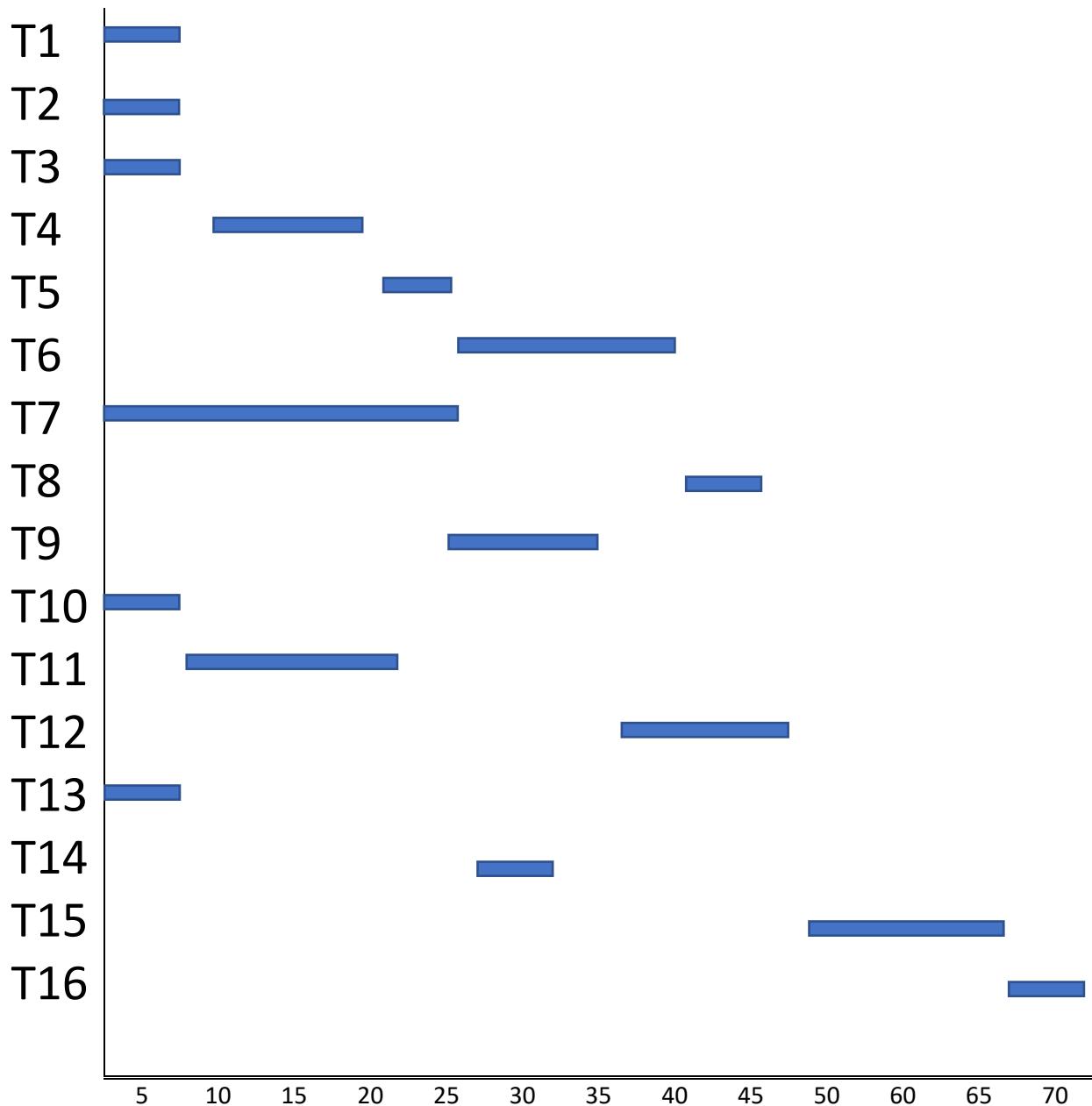
Minimizing faults and maximizing user-friendliness will be Ali's top priorities. Ali has the ultimate power for all documentation and has to ensure that it is up to date.

## 12 & 13 - ACTIVITY CHART, MILESTONES, DELIVERABLES, CRITICAL PATH

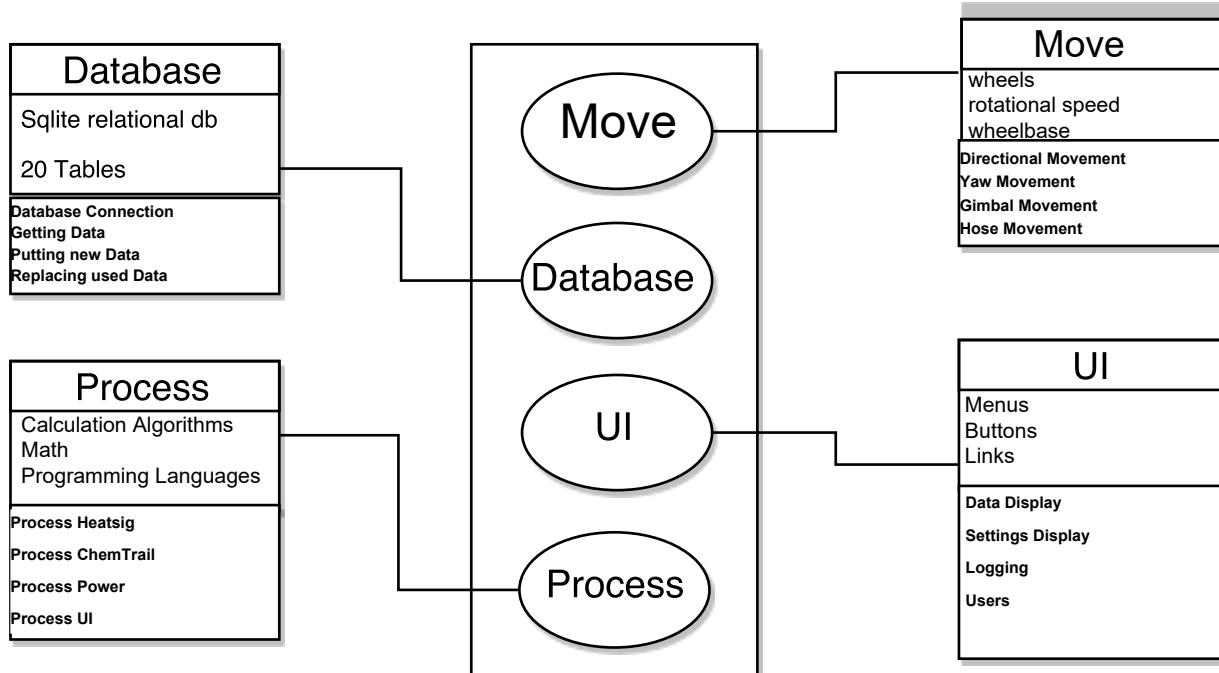
| Task | Description   | Duration (days) | Dependencies |
|------|---|-----------------|--------------|
| T1   | Directional Movement  | 5               |              |
| T2   | Yaw Movement  | 5               | T2           |
| T3   | Gimbal Movement   | 5               |              |
| T4   | Setup Database Connection   | 15              | T1,T2,T3     |
| T5   | Hose Movement   | 5               |              |
| T6   | Set database systems and variables  | 15              | T4           |
| T7   | Code out processing algorithms for the heat signatures and chemTrail signatures | 20              |              |
| T8   | Process algorithm on data and setup organization of data in db                  | 5               | T5,T6,T7     |
| T9   | Code script to process user input from controller                               | 10              | T11          |
| T10  | Design the user interface outlook   | 5               |              |
| T11  | Code the menus according to design  | 15              | T10          |
| T12  | Code out display of robot information such as battery or power                  | 10              | T8,T9        |
| T13  | Setup connection with 3rd Parties   | 5               |              |
| T14  | Code authentication of user using 3rd party softwares                           | 5               | T13, T5      |
| T15  | Create Settings Framework(Back-End)   | 20              | T5,T8,T9,T14 |
| T16  | Code Encryption, Analytics, and maintenance code                                | 5               | T5,T9        |



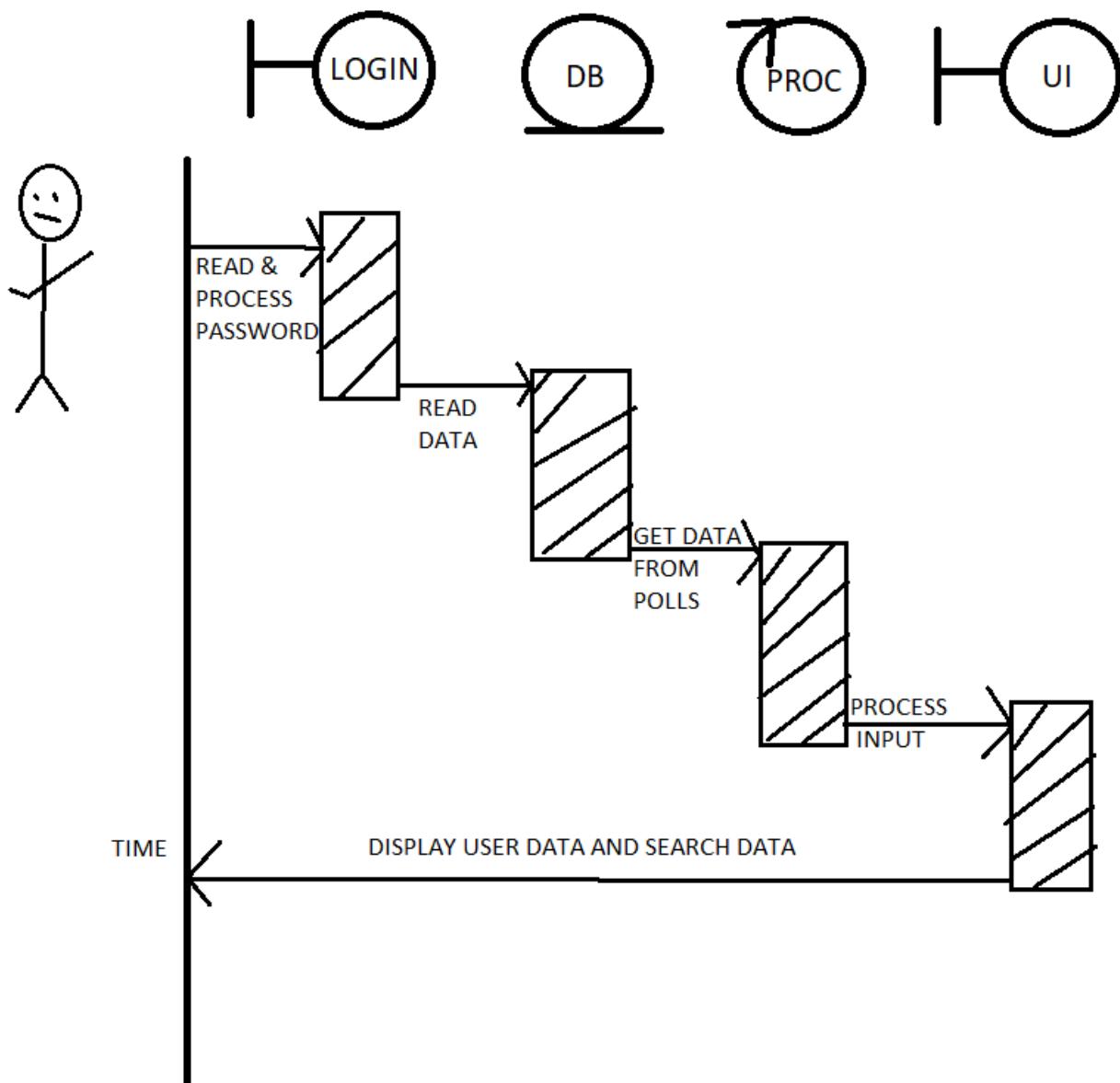
# 12 – BAR CHART



## #14 - UML



# 15 - SEQUENCE DIAGRAM



# 17 – TEST PLAN

- **System:**
  - Connect: Movement Subsystem
  - Connect: Data Storage Subsystem
  - Connect: User Interface SubSystem
  - Connect: Processing Subsystem
- **Subsystem:**
  - Movement:
    - Run: Directional Movement
    - Run: Yaw Movement
    - Run: Gimbal Movement
    - Run: Hose Movement
  - Data Storage:
    - Run: Database Connection
    - Run: Get Data
    - Run: Put New Data
    - Run: Replace Data
  - User Interface:
    - Run: Data Display
    - Run: Settings Display
    - Run: Logging
    - Run: Users
  - Processing:
    - Run: Process Heatsig
    - Run: Process ChemTrail
    - Run: Process Power
    - Run: Process UI
- **Unit (UI Logging In System):**
  - U: Enter “John Smith”
  - S: Error “john smith” is not recognized
  - U: Enter “JohnSmith”
  - S: Ok. Enter Password
  - U: “\*\*\*\*\*”
  - S: Error “Must be longer than 8 digits”
  - U: “\*\*\*\*\*”
  - S: OK.

# **18 – MAINTENANCE PLAN**

## **Daily Maintenance**

- Perform Backup(Automatic) of database and crucial sub-systems
- Update Plugins(Automatic)
- Check for spikes in Network
- Review any issues sent from Analytics, Security, or Email Servers

## **Monthly Maintenance**

- Check if all pages load properly.
- Check for any broken links
- Check for 404 Errors.
- Check for any type of Console errors.

## **Monthly Maintenance**

- Check website loading speed.
- Review security scans and resolve any issues
- Review website statistics and evaluate conversion rates.
- Review local visibility and search engine optimization.

## **Quarterly Maintenance**

- Review website – what could be improved?
- Check for Outdated 3<sup>rd</sup> party libraries or software.
- Review and tweak meta title and meta description tags
- Test and tweak website to improve conversion rates.
- Test Website for browser compatibility.
- Check the uptime logs

## **Yearly Maintenance**

- Update the copyright date in footer
- Review each page of the site for content accuracy
- Renew SSL certification if needed.
- Check backup health by restoring the most recent backup to a separate web server
- Validate your site. (CSS/HTML, Accessibility, Mobile-friendly)
- Review your website strategy to align with your business goals.

## 16 – WEB SITE CODE

```
<html lang="en-US"><head>
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="chrome=1">
<title>CS350PROJEKT</title>
<meta property="og:title" content="CS350">
<meta property="og:locale" content="en_US">
<meta name="description" content="CS 350 PROJECT FALL 2017">
<meta property="og:description" content="CS 350 PROJECT FALL 2017">
<meta property="og:url" content="https://alikalkandelen.github.io/CS350/">
<link href="https://fonts.googleapis.com/css?family=Arvo:400,700,400italic" rel="stylesheet" type="text/css">
<link rel="stylesheet" href="https://pages-themes.github.io/dinky/assets/css/style.css?v=46349262f43f70d5dc78cf83775850b0466aa573">
<script src="https://pages-themes.github.io/dinky/assets/js/scale.fix.js"></script>
<meta name="viewport" content="width=device-width, initial-scale=1, user-scalable=no">
<!--[if lt IE 9]>
<script src="//html5shiv.googlecode.com/svn/trunk/html5.js"></script>
<![endif]-->
<style>
header{
padding: 34px 80px 22px 50px;
}
</style>
</head>
<body>

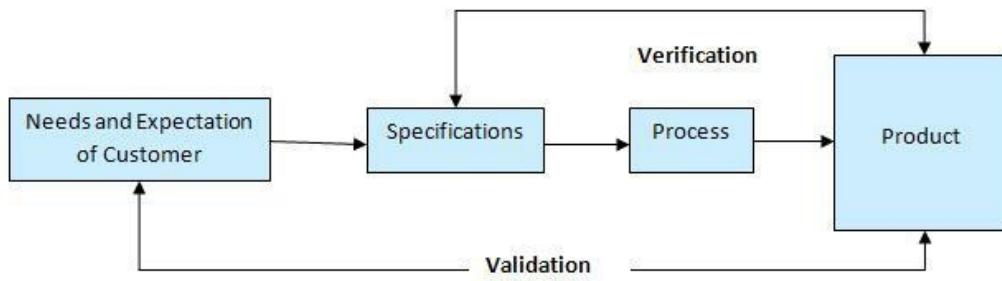
<div class="wrapper">
<header>
<h1 class="header">BRAINSTREAM</h1>
<p class="header">CS350 PROJECT FALL 2017</p>
<ul>
<li class="download"><a class="buttons" href="combinepdf.pdf">Download PDF</a></li>
<li class="download"><a class="buttons" href="projectfiles.zip">Download ZIP</a></li>
```

```
</ul>

<p>Ali Kalkandelen <br> Samuel Owusu-Biney <br> Stephen Kilnisan</p>

</header>
<div id="results" class="hidden"></div>
<section id="example1">
    HELLO WORLD
</section>
<script src="pdfobject.min.js"></script>
<script>
    var options = {
        pdfOpenParams: {
            pagemode: "thumbs",
            navpanes: 1,
            toolbar: 1,
            statusbar: 0,
            view: "FitV"
        }
    };
    var myPDF = PDFObject.embed("project.pdf", "#example1", options);
    var el = document.querySelector("#results");
    el.setAttribute("class", (myPDF) ? "success" : "fail");
    el.innerHTML = (myPDF) ? "" : "The PDF embed Didn't Work. Please try another browser or deleting your cache and trying again.";
</script>
</div>
<!--[if !IE]><script>fixScale(document);</script><![endif]-->
</body>
</html>
```

## 20 - VERIFICATION AND VALIDATION



|                   | <b>Validation</b>   | <b>Verification</b>  |
|-------------------|---|--|
| <b>Questions:</b> | <ul style="list-style-type: none"><li>• Does the final product meet the business needs of the customer?</li><li>• Does the product meet all the testing requirements?</li></ul> | <ul style="list-style-type: none"><li>• Does the product according to the specifications?</li><li>• Does the implementation meet the design?</li><li>• Does the product follow the proper cycle?</li></ul> |
| <b>To do:</b>     | <ul style="list-style-type: none"><li>• Execute the software</li><li>• Test executed software (alpha,beta,FAT)</li><li>• Validate product with business</li></ul>               | <ul style="list-style-type: none"><li>• Review specifications and implementation, making sure nothing is missed.</li><li>• Review the Requirements and match it with the product</li></ul>                 |

## **21 - COCOMO**

**Nominal Effort:  $3.2 \times (\text{KDSI})^{1.05}$**

Estimated DSI = 4000

$$3.2 \times (4)^{1.05} = 13.72$$

$(1.15)(1.08)(.85)(1)(1)(1)(.87)(1.19)(.91)(.86)(1.1)(.95)(.82)(.91)(1.1)$

= .74

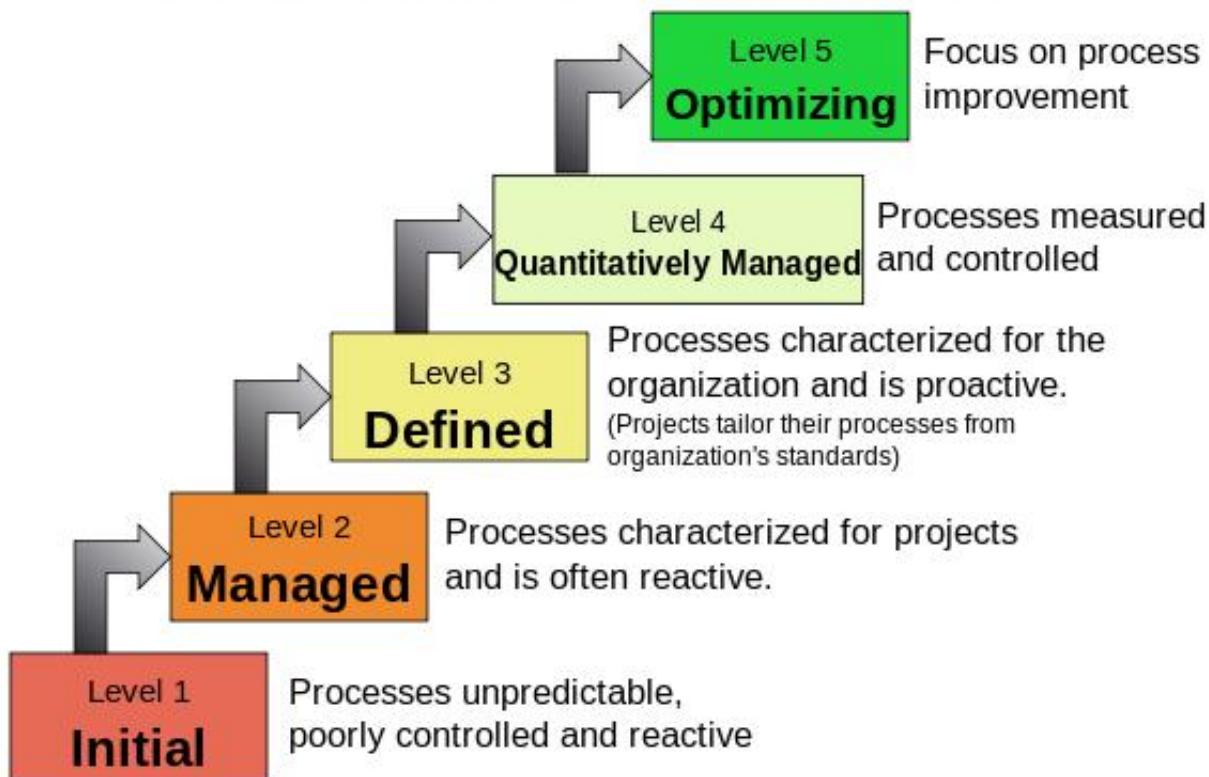
**$14.72 \times .74 \approx 11 \text{ Person-Month}$**

# 22 - Decommissioning Plan

- Determine Retirement Strategy
  - Is the program in full retirement or migrating to a newer system?
  - Will the retired program be backed up or purged forever?
  - How many people are involved in the current system?
  - Size of Database? Size of Code? Size of Traffic?
- Database:
  - Database Refactoring to newer software, or complete, safe deletion if full retirement.
  - Backups are deleted or migrated depending on the decision
- Documentation:
  - Docs are updated to include decommissioning portions and plans
- Users:
  - Users are informed of migration or removal.
  - Users are directed to a new system in a seamless manner
  - Users receive proper training into understanding new system
- Implementation:
  - Remove all code from server.
  - Delete proper files and folder structures.
  - Backup to another PC if needed
- Business:
  - Decommission costs determined.
  - Staff is properly dismissed or repositioned
  - Business approves plans and budget
- Hardware:
  - Hardware is upgraded or recycled depending on circumstances
  - Battery is properly disposed
  - Non-recycled parts are scrapped

# 23 - CAPABILITY MATURITY MODEL

## Characteristics of the Maturity levels



CMM LEVEL PICKED: **LEVEL 2 - MANAGED**

Reasons:

- The characterization of projects are well defined
- Processes for the project are clear and explanatory.
- Software is from a brand new group, so no organizational standards are set.
- Processes are defined but not well controlled.
- Processes have no definition for improvement or proactive for the future.

COST PER PERSON : \$20,000 Per Month Per Person. Based

on 11 person month \* 20K = **\$220,000 For Project.**

# 24 - DATED LOG

| Person Name     | Person Position    | Description                                  | Date       |
|-----------------|--------------------|--|------------|
| Alan Smith      | Operations Manager | Set-Up Orgnization structure and personnel   | 01/01/2018 |
| John Adams      | Database Analyst   | Made priliminary database structures         | 01/20/2017 |
| John Doe        | Programmer         | Tech stack setup and analysis                | 01/22/2017 |
| Jane Doe        | Senior Analyst     | Major change in life cycle method            | 02/10/2017 |
| Sam Silverstein | Programmer         | Changed tech stack to accomodate project     | 02/20/2017 |
| Tom Turner      | Project Manager    | Added developers to project to speed up prod | 02/31/2017 |
| Adam almosa     | Assistant VIP      | provided additional funding to proj          | 03/01/2017 |
| Laurie Comes    | Secretary          | Made updates to office space                 | 03/02/2017 |