MECHTRON 4TB6: Development Process

LifeLine

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1 Overall Process Workflow

1. Sensor selection for body temperature, blood pressure, and heart rate as well as micro-controller
    - Input: Literature review
    - Output: Bill of Materials (BOM)
    - Acceptance Criteria: Bill of Materials (BOM) for all sensors is finalized including the model of each sensor, the source where it is to be acquired, the price and the lead time.
    - Tools Required: none
2. Electrical schematics development
    - Input: Sensors and micro-controller
    - Output: Completed schematics and block diagrams
    - Acceptance Criteria: Bill of Materials (BOM) for micro-controller and all electrical components is finalized including the model of each component, the source where it is to be acquired, the price and the lead time. System block diagrams are finalized. PCB schematics and Gerber files are finalized.
    - Tools Required: Autodesk Eagle 9.6.2 (latest version as of the creation of this document), Lucidchart
3. Selected sensors, micro-controller, and peripherals acquisition
    - Input: Schematics, Bill of Materials (BOM)
    - Output: Parts for validation and verification
    - Acceptance Criteria: All items specified in the sensor and electrical component Bills of Materials (BOMs) have been acquired.
    - Tools Required: none
4. Parts validation and verification
    - Input: Parts (sensors, micro-controller, peripherals)
    - Output: Test results and validated parts
    - Acceptance Criteria: All parts are in working order and comply with the stated specifications.
    - Tools Required: Oscilloscope, breadboard, power supply
5. Electrical circuit assembly
    - Input: Schematics, sensors, micro-controller, circuit board, and peripherals
    - Output: Electrical circuit
    - Acceptance Criteria: All wires are neat, tidy, and secure. Each component is functioning within the limits specified on the datasheet. The circuit is cool in room temperature.
    - Tools required: Soldering iron, oscilloscope
6. Display output and formatting
    - Input: Multiple sensor inputs from each sensor that will be measured and evaluated.

- Output: Display with quantitative measurements from sensors with acceptable presentation of display.
- Acceptance Criteria: All code is tested and displayed appropriately
- Tools required: IDE for chosen programming language, Git for tracking changes

7. Code development
    - Input: Programming Sequence Flowchart
    - Output: Fully functional code for the device
    - Acceptance Criteria: Clear, well-commented code. Display, micro-controller, and electrical assembly is fully functional and meets all requirements. Signal noise is adequately filtered to provide usable data. Primary vitals data is visible on the display.
    - Tools Required: IDE for chosen programming language, Git for tracking changes
8. CAD model of device housing
    - Input: Electrical circuit assembly dimensions
    - Output: CAD model
    - Acceptance Criteria: CAD model houses all electrical components and meets weight and dimension requirements. CAD model is possible to manufacture using available tools such as 3D printers and laser cutters.
    - Tools Required: Autodesk Inventor 2022.1.1 (latest version as of the creation of this document)
9. Device housing assembly
    - Input: 3D printing material, hardware (nuts, bolts etc.)
    - Output: Completed device housing
    - Acceptance Criteria: Assembled housing meets weight, dimension, safety, and durability requirements. Housing securely fits all electrical components as intended.
    - Tools Required: 3D printer, laser cutter
10. Device assembly
    - Input: Electrical circuit, device housing
    - Output: Fully assembled device
    - Acceptance Criteria: Assembled device meets weight, dimension, safety, and durability requirements. Housing securely fits all electrical components as intended. Device can be safely used while following the normal operation procedure.
    - Tools Required: Adhesives, hardware, tools
11. Verification and validation
    - Input: Fully assembled device
    - Output: Test results

- Acceptance Criteria: Primary vitals measured by LifeLine (body temperature, blood pressure, and heart rate) are verified against standard vitals' measurement techniques. The device meets the accuracy specified in the project requirements. Device fully meets all functional requirements specified per the latest revision of the project requirements document.
- Tools Required: Oscilloscope, reference devices for vitals' measurements

2 Version Control

The project members are expected to use a Github Repository in order to keep track of all software changes and have a stable build at all times. In order to make sure the changes creates by other will not affect this process, they will work on other branches and commits which will then be merged after verifying with all team members. Tests can be done separately.

Github can also help with creating and assigning tasks to the members of this project and keep track of due dates as well.

All software developed for the LifeLine device shall be version controlled through the team's Git repository. All CAD models developed for the LifeLine device shall be version controlled through the team's Git repository.

3 Project Standards

All diagrams and schematics will be clearly identifiable and include the title, designer's name, date, revision number, and scale. To generate a Bill of Materials for the required parts, Autodesk Eagle will be used. Autodesk Eagle and Inventor will be used to generate any electrical and mechanical schematics, respectively. The Group 30 Microsoft Teams channel will be the primary method of communication between group members. All reports will be generated using Overleaf, an online LaTeX editor. Any flowcharts or block diagrams will be created using Lucidchart, a web-based platform for creating charts.

3.1 IPC Standards

Due to the scope of this project, the device will not conform to IPC Class 3 standards for electronics which is typically required for medical devices. However, IPC standards and best practices will be used wherever possible.

4 Roles and Responsibilities

4.1 Emily Crowe - Electrical and Biomedical

- Sensor selection for body temperature, blood pressure, and heart rate as well as micro-controller
- Parts validation and verification
- Electrical circuit assembly
- Device assembly
- Verification and validation

4.2 Arthur Faron - Mechatronics

- CAD model of device housing
- Device housing assembly
- Code development
- Device assembly
- Verification and validation

4.3 Danushka Fernando - Electrical

- Sensor selection for body temperature, blood pressure, and heart rate as well as micro-controller
- Selected sensors, micro-controller, and peripherals acquisition
- Electrical circuit assembly
- Device assembly
- Verification and validation

4.4 Yerin Thevarajah - Software and Embedded Systems

- Sensor selection for body temperature, blood pressure, and heart rate as well as micro-controller
- Display Output and Formatting
- Code development
- Device assembly
- Verification and validation

4.5 Phillip Truong - Electrical and Biomedical

- Sensor selection for body temperature, blood pressure, and heart rate as well as micro-controller
- Electrical circuit assembly
- Electrical schematics development
- Device assembly
- Verification and validation

4.6 Avoidance of failures in processes

Whenever a group member encounters a delay in the completion of a stage in the project, these delays must be communicated to the rest of the group members. It is important to maintain contact among group members as a delay in one portion of the development process can affect another portion. Group members are also encouraged to assign specific due dates for themselves that are before the actual due date so that there is adequate time available to make any necessary modifications.

5 Change Management

- This can be done using the Git Repository for the software portion and documentation for other portions, as a new issue can be made which will automatically inform the rest of the members
- A new branch can be created
- The code will be tested against the new code and the code that is already in place to make sure the code changes will not negatively affect other parts of the project
- Unit testing can be used for this
- Once verification and approval from all members is obtained, the branch can then be merged
- Issue is then closed