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Keywords—component, formatting, style, styling, insert (key words)

# Introduction (*Heading 1*)

This template, modified in MS Word 2007 and saved as a “Word 97-2003 Document” for the PC, provides authors with most of the formatting specifications needed for preparing electronic versions of their papers. All standard paper components have been specified for three reasons: (1) ease of use when formatting individual papers, (2) automatic compliance to electronic requirements that facilitate the concurrent or later production of electronic products, and (3) conformity of style throughout a conference proceedings. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

# Ease of Use

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# Design

## Idea and Concept

To design is to plan how a product or a service will look and function. A design process follows a linear process of exploration of a problem, solutions to this problem and then executing on the adequate solution. The methodology design used for our rescue robot implemented a sequential design where all the fields are interrelated, because some modifications in one stage can modify decisions in other stages, and this interrelation can provide some problems with a simple solution.

1. **Mechanical Design**

The first step in the process is the mechanical design. The goal of this step is to define all the features for the movement of the robot. These features can be obtained by answering the following questions: Which surface types will the robot move on? How much weight will the robot be capable of carrying? What form will the robot have? How will the robot carry out transmission of motion? Which type of motor will the robot use for motion? The information obtained with these questions is necessary to have a clear goal, while keeping the objectives that we want to achieve.

1. **Control Design**

In the second step it is necessary to know how the control systems will work. For this reason, it is necessary. We define control variables, select the best sensors to measure each control variable, analyze the variables to define the features of the controller, as well as how many inputs and outputs, (digital or analogue), the controller needs.

1. **Electronic Systems Design**

This step aims to define the circuits for the robot operation, which calls for design of the following elements: signal conditioners, motors power circuits, control circuits, if the controller will be analogue, or circuits like microcontroller or microprocessor, if the circuits will be digital.

1. **Electrical Design**

This stage defines whether the robot will be battery-powered, or wire-powered. With all the steps done it is possible to proceed with the final step of the design process. This final step consists of the algorithms of control.

1. **Algorithms of Control**

In this step, the algorithms that are in charge of the behavior of the robot are designed. The algorithms must be able to make the synchronization of all the signals received from the sensors and the motion of the motors. Finally, it is very important to know that these are the general steps for the design process of a climbing robot, and if they are followed, good results will ensue.

## Material Used

The material used to build a robot might come as an afterthought to some robotics developers, but of course the choice of materials will affect its safety, durability, and even aesthetics. Any design project should include considerations of how a robot will move, whether it will operate around people, what tasks it will perform, and the anticipated environment. Since our robot will most likely operate around people in rescuing patients no matter whether it is on land or water, so we came out with some ideas on what materials should we use and consider, to build our robot. The materials chosen for each subsequent part are as listed below:

1. The chassis is made of light steel. The reason behind this is to increase its durability so that it can withstand a compromised weight and pressure both when operating and moving on land and water. The weight should also be a bit light to ease the robot to float on water but should not be too light so that it can move smoothly on land.
2. The robot’s interior should be water and salt-resistant so that it can be driven both in the sea or ocean.
3. The compartments inside the robot should be fitted well on onto another to avoid any leaking or any water to fill into the robot and later making it heavy enough to be submerged in the water whenever the robot enter the water.
4. As for the safety precaution, the high voltage electrics and the electronic parts in the robot should be well shielded, so that there is no risk of electrocution. We should give serious attention on this part as it is a really important and essential element on our robot. Therefore, this matter should be taken into consideration as the Murphy’s law stated that “Anything that can go wrong will go wrong”.

## Early Sketch

In this fragment of project, which is in the design part, we decided to go for the Paper Prototyping approach in order to realize our real prototype for our ResQ Robot. Paper Prototyping is a throwaway prototyping that involves creating a rough, hand sketch, drawings of an interface to use as prototypes, models or designs. It is also an original type, form or an instance that serves as a model on which later stages are based on and judged. So, we came out with a rough hand sketch and measurement as an early sketch for our robot as shown in the figure below.

Diagram, engineering drawing

Description automatically generated

Fig. 1 Early sketch of ResQ Robot

In this section, we also include the measurements of our robot in real-life size and also how big it will be in the prototype. We were given a task to create the prototype of our robot with the dimension not more than 30cm x 20cm x 20cm.

1. measurement of the each robot parts in real life

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Tyre | Shaft | Chassis | Wheel |
| Length/cm | 45.0 | 181.0 | 300.0 | 30.0 |
| Width/cm | - | - | 150.0 | - |
| Height/cm | - | - | 100.0 | - |
| Radius/cm | 25 | 5.9 | - | 80 |

1. measurement of the each robot parts in prototype

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Tyre | Shaft | Chassis | Wheel |
| Length/cm | 4.5 | 18.1 | 30 | 3 |
| Width/cm | - | - | 15 | - |
| Height/cm | - | - | 10 | - |
| Radius/cm | 2.5 | 0.59 | - | 8 |

So, in the prototyping part, we have decided to create our robot’s prototype with the scale of 1:10 to meet one of the requirements in our task.

## 3D Modelling

3D modeling has changed the way we design; for the better. Not only does 3D modeling help the designers and end users visualize space requirements, but also improves drawing efficiency and accuracy. 3D modeling for design allows the designer to see what they would not see when designing in 2D. It gives the designer the ability to physically see how much real estate an object takes from all perspectives. When designing in 2D, the designer needs to create a separate plan and elevation view to see the space requirements of an object, which takes longer to do.

When designing in 3D, the design is done in one model. Whereas when a design is done in 2D, it is typically done in multiple models, one for each view. By doing a design in multiple models it creates an atmosphere where more mistakes can occur by having information duplicated. When a design is done in 3D, it assists designers with coordination. The designer can walk through a 3D model with specialized software and see the actual size and space of the design. It also allows the designer to see if their designs conflict with other disciplines or existing conditions they may not readily see in 2D. The 3D walkthrough software also allows the designer to run interference checks to see if the design clashes with other items in the 3D model. By using the 3D walkthrough software, the designer can easily see whether the design allows for equipment maintenance access and operational access, and addresses safety concerns. This allows the designer to create a more user-friendly design for the end user.

By designing in 3D, the designer can also review a design using the 3D walkthrough software with the end user. This is particularly helpful for end users who have a hard time to visualize designs from 2D drawings. This allows them to see how much clearance and access they will have around a design before it is physically built.

The advantages of 3D modeling for designers is not limited to productivity and coordination, it is an excellent communication tool for both the designer and end user. 3D models can help spark important conversations during the design phase and potentially avoid costly construction mishaps.

In this project, we decided to use the SOLIDWORKS software to realize all of the parts separately first and then combined it altogether later on to have the whole view of the robot’s prototype. Subsequently, each of the design of our robot’s parts will be explained in more detail to give the reader a better understanding of our projects and how it will work. We will also explain the purpose of each feature included in our design in each part.

Tyre & Shaft

Figures below show the tyre that we will use in our robot to move on the land. We decided to connect both front tyres directly to the motor to control and maneuver the direction employed to the tyres in order to steer it according to the desired direction. The tyres are also connected to caps to avoid water from entering the body parts when moving in water. Other than that, we also include the features of the edges on the tyres to increase friction when it moves on the land. For example, increasing the grip when the robot is moving on the sand or muddy areas. The edges also will help to overcome some obstacles on the ground such as pebbles and stones while moving to the target or destination.

A picture containing gear, metalware, wheel

Description automatically generated

Fig. 2.1 Front view of tyre

A picture containing comb

Description automatically generated

Fig. 2.2 Top view of tyre

A close-up of a cd

Description automatically generated with medium confidence

Fig. 2.3 Isometric (I) view of tyre

A picture containing gear, metalware

Description automatically generated

Fig. 2.4 Isometric (II) view of tyre

Meanwhile for the rear tyres, we designed as if it is not connected to any motor at all. Instead, we connected both tyres on the rear part with a shaft. Basically, they will just follow the movements of front tyres and just rotating by the help of the shaft connecting both tyres left and right.

Shape

Description automatically generated

Fig. 2.5 Isometric view of shaft

Water Wheel

Next, we come to the most important components that will play a big role when the robot is moving on water. We designed two water wheels that will be placed on the center of the robot, which is between the front and rear tyres. The wheels are placed a bit higher compared to the tyres because we designed it only to move whenever our robot is floating on the water. The reason behind this is to reduce the amount of energy used when the robot is moving on land since both water wheels are connected directly to the motor as well.

Aside from that, we also decided to design the water wheels with some blades to mimic a propeller. As we know. propeller is a device with a rotating hub and radiating blades that are set at a pitch to form a helical spiral, that, when rotated, exerts linear thrust upon a working fluid, such as water or air. Propellers are used to pump fluid through a pipe or duct, or to create thrust to propel a boat through water. The blades are specially shaped so that their rotational motion through the fluid causes a pressure difference between the two surfaces of the blade by Bernoulli's principle by exerts force on the fluid, which then will allow to move the robot forward or backward. Not to forget, since both wheels are connected directly to the motor, the robot will also be able to move to the left or right.

Icon

Description automatically generated

Fig. 3.1 Front view of wheel

A picture containing fan

Description automatically generated

Fig. 3.2 Isometric view of wheel

Chassis

Here we come to the strongest part of our robot which is chassis. The chassis will act like a body, it needs to be strongly built and well design to hold other parts or components at the robot. As we mentioned earlier, the material used for chassis is light steel which for\_\_\_\_\_\_\_. For the design of our rescue robot, we inspired from the design of a tank as shown in the figure below.

A picture containing text, box

Description automatically generated

Fig. 4.1 Isometric view of chassis

Graphical user interface, application

Description automatically generated

Fig. 4.2 Side view of chassis

In order to make our robot able to move or float on water, we also consider buoyancy factor. We have increased the volume of the robot to increase the buoyancy. The model of our robot consists of aerodynamics to ensure our robot can move through air or surroundings easier and faster.

Electronics

These are the electronics components that been used in our robot. Firstly, we are going to attach 4 motors with front tyres and wheels. They are important to certify all of the tyre and wheels keep rotating synchronous and simultaneously.

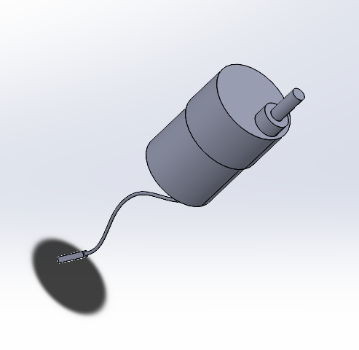


Fig. 5.1 Motor

Second is Arduino. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read inputs such as light on a sensor or a finger on a button and then turn it into an output such as activating a motor or turning on an LED. Here, on this single board, all the electronics components are connected.

Diagram, engineering drawing

Description automatically generated

Fig. 5.2 Arduino UNO

Lastly is ultrasonic sensors which work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object. The purpose we use ultrasonic sensor is to calculate better distance of obstacles with our robot so it can avoid or overcome it.

A picture containing circle

Description automatically generated

Fig. 5.1 Ultasonic Sensor

Final Prototype

After combining all the parts stated before, we finally come to the final prototype of our robot which portrays the complete side of the robot. We also provided some figures as an aid for a better understanding on our robot.

A close-up of a box

Description automatically generated with low confidence

Fig. 6.1 Isometric view of the robot

Diagram

Description automatically generated

Fig. 6.2 Top view of the robot

Shape

Description automatically generated

Fig. 6.3 Side view of the robot

A picture containing diagram

Description automatically generated

Fig. 6.4 Front view of the robot

## Printing

As what has been suggested by our professor, we have used a software called Ultimaker Cura to calculate the total estimation time to 3D print our robot. After inserting each parts of our combined prototype in the software space, we have calculated the total time of 3D printing of ResQ Robot and the result shows that the total time taken to print each single part of robot is 33 hours and 26 minutes as shown in the figures below.

A screenshot of a computer

Description automatically generated with medium confidence

Fig. 7.1 3D printing (I)

A picture containing graphical user interface

Description automatically generated

Fig. 7.2 3D printing (II)

* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
* A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
* Do not use the word “essentially” to mean “approximately” or “effectively”.
* In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
* The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

# Using the Template

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

## Authors and Affiliations

**The template is designed for, but not limited to, six authors.** A minimum of one author is required for all conference articles. Author names should be listed starting from left to right and then moving down to the next line. This is the author sequence that will be used in future citations and by indexing services. Names should not be listed in columns nor group by affiliation. Please keep your affiliations as succinct as possible (for example, do not differentiate among departments of the same organization).

### For papers with more than six authors: Add author names horizontally, moving to a third row if needed for more than 8 authors.

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#### Selection: Highlight all author and affiliation lines.

#### Change number of columns: Select the Columns icon from the MS Word Standard toolbar and then select the correct number of columns from the selection palette.

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## Identify the Headings

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced. Styles named “Heading 1”, “Heading 2”, “Heading 3”, and “Heading 4” are prescribed.

## Figures and Tables

#### Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation “Fig. 1”, even at the beginning of a sentence.

1. Table Type Styles

| Table Head | Table Column Head | | |
| --- | --- | --- | --- |
| Table column subhead | Subhead | Subhead |
| copy | More table copya |  |  |

1. Sample of a Table footnote. (*Table footnote*)

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

##### Acknowledgment *(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

##### References

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Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

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