

**Project DZERV**

**Disaster Zone Emergency Response Vehicle**

Spring 2012-Fall 2012

Group F

Group Members:

Marcial Rosario

Robert Smith

Michael Lopez

**Participant Identification**

The project being proposed is the Disaster Zone Emergency Response Vehicle, a self-contained search and rescue vehicle which will minimize the need for direct human personnel involvement in search and rescue operations involving dangerous conditions. The students working on this project include Marcial Rosario, Michael Lopez, and Robert Smith. Marcial and Robert are both electrical engineering majors, who will be involved in designing the electrical control systems for this project, and Michael is a computer engineering major, who will be heavily involved in developing the software applications for our vehicle.

**Motivation**

With the technologies available to us today, human safety in accomplishing certain tasks is becoming increasingly more feasible. Specifically, activities such as search and rescue operations in environments not conducive to human safety are more realizable today than they were in the past. The motivation behind this project is that we intend to create a vehicle capable of entering these types of environments and being able to search for and detect the presence of humans and inform a remote operator so that further action can be taken.

**Project Description**

**Microcontroller**

At the heart of this operation lies the microcontroller. We will use this to connect all the components for this vehicle to one another. This is where the data processing, number crunching, and communication will take place. This piece of hardware will control the camera, various sensors, and output the data to the interface.

**Camera and Sensors**

In order to aid in a search-and-rescue operation, a camera will be necessary so that a remote operator can guide the vehicle through the affected area. Various sensors will be included to help determine certain conditions in the area and help determine whether human involvement will be safe. We intend to include barometric pressure sensor to help detect the presence of an explosion, a temperature sensor to determine the temperature of the immediate area and determine whether it is too hot for a human to enter the area, and also a range finder to assist in determining distances from certain landmarks or other objects to aid in navigation.

**Graphical User Interface**

Finally, to tie everything together, we will need some sort of user interface so that a remote operator can actually operate the vehicle. Much of the actual interfacing will be done on the microcontroller level, but the actual part that the user will see needs to be implemented via a GUI so that the vehicle can be easily controlled, and so that the user will be able to see the various conditions which we will be measuring with the sensors in order to make the judgment calls necessary to take the necessary actions in an actual search-and-rescue operation.

**Overall Goal**

In summary, we intend to create a search and rescue vehicle capable of measuring certain parameters of the area in which it is located, determine whether it is safe for a human to enter this area to complete the rescue aspect of the search-and-rescue operation, and communicate this information to the operator. We also intend on having this vehicle cost as little as possible, minimize its power consumption, all the while maintaining a relatively simple and easy-to-implement design.

**Technical Specifications**

The chassis that we have picked out for this project comes standard with a 6 V battery source. However, we feel that this is insufficient for what we will need we are going to implement two external 9.6 V rechargeable sources.

The processor we are implementing in our design is the PIC16F876. There are only 35 single word instructions to learn which makes things less complicated in terms of coding. It operates at 20 MHz and provides 8K of flash memory, which should be sufficient for the tasks we want our robot to do. At 3 V and 4 MHz, the output current is around 0.6 mA which will allow power consumption to be low. It also comes with a 10 bit ADC which will be used by our sensors.

As far as transmitting data, we went with the TXM-916-ES transmitter. The typical operating range for the part is around 3 V which is consistent with most of our parts. It’s able to transmit up to 916 MHz and handle a relatively high data rate of 56,000 bits per second, which is more than enough for our requirements. Our receiver, the RXM-916-ES can handle the same amounts of data.

The standard remote control car weighs 4.56 pounds. We wanted a camera that was also relatively lightweight. We chose the XC17A model made by X10. It weighs only 0.34 pounds which will allow us to keep the weight of the vehicle low. It requires 12 V DC power and allows for 60 degrees of motion. It produces 80 mA of output current, which will take up most of the power we want our robot to output.

The pressure sensor we decided on was the MPL115A1. This sensor can work in conditions varying from -40 to 105 degrees Celsius which is great for practically any environment we would use it in. Its ultra-low current consumption (5 micro amps during active mode and only 1 micro amp in sleep mode) allows us to maintain our goal of low power consumption. This part requires anywhere from 2.375-5.5 V which, again, can be regulated to fit these specs. Our sensor has the ability to detect anywhere from 50-115 kPa which is suitable to tell us what kind of environment we are in and will allow for us to properly gauge if it is safe or not.

We chose to go with the RHT03 temperature and humidity sensor. It is accurate up to +/- 0.5 degrees Celsius. It can operate in temperatures from -40 to 80 degrees Celsius and since the response time of the part is 2 seconds for both temperature and humidity readings, we can evaluate whether our robot is going to be safe in these conditions in plenty of time. This part operates anywhere from 3.3-6 V which can be regulated. The operating range of this part is around 100 meters, and since this lies well inside the range we want our robot to travel between 120-150 feet this works out nicely.

**Hardware Block Diagram:**

Pic μC

RF Transmitter

RF Receiver

User Controlled PC

Ultrasonic Range Finder

Video Camera

Temp./Humidity Sensor

Pressure Sensor

LED Bar

**Software Flowchart:**

Open Serial Port

Navigate Robot via Keyboard Arrows

Process Incoming Sensor Readings

Print Sensor Readings to User

Quit Motion/Program

No

Yes

**Project Budget/Financing:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Unit Number | Unit Cost | Quantity | Cost |
| **Materials** |  |  |  |  |  |  |
|  | Microcontroller |  | PIC 16F876 | $5.99 | 1 | $5.99 |
|  | μC Transmitter |  | TXM-916-ES | $13.84 | 1 | $13.84 |
|  | μC Receiver |  | RXM-916-ES | $17.12 | 1 | $17.12 |
|  | Video Camera |  | X10 PlanetCam | $129.99 | 1 | $129.99 |
|  | Ultrasonic Range Finder |  | LV-EZ1 | $25.95 | 1 | $25.95 |
|  | Pressure Sensor |  | MPL115A1 | $11.95 | 1 | $11.95 |
|  | Temperature/Humidity Sensor |  | RHT03 | $9.95 | 1 | $9.95 |
|  | PCB |  |  |  | 1 | $100 |
|  | Chassis |  | 1:14 R/C FF 6v Hummer | $29.99 | 1 | $29.99 |
|  | LED Bar |  | COM-00678 | $2.95 | 1 | $2.95 |
|  | Wires |  |  |  |  | $10.00 |
|  |  |  |  |  |  | **$357.73** |
| **Tools** |  |  |  |  |  |  |
|  | Soldering Iron |  |  | LAB | 1 | $0.00 |
|  | Solder (spool) |  |  | LAB | 1 | $0.00 |
|  | Wire Stripper/Cutter |  |  | LAB | 1 | $0.00 |
|  | Screwdriver |  |  | LAB | 1 | $0.00 |
|  | Workbench Tools (sander, drill press, etc.) |  |  | LAB | 1 | $0.00 |
|  | Hammer |  |  | LAB | 1 | $0.00 |
|  |  |  |  |  |  |  |
| **Total** |  |  |  |  |  | **$357.73** |

Price Breakdown

**Project Milestones:**

This section presents the plan that our group has established as a reference, and will attempt to follow, in order to keep track of responsibilities and guidelines which we must accomplish in the upcoming months. The chart below takes into consideration that we will not be completing EEL 4915 until the Fall 2012 semester.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **Project Name** | **Days** | **Start** | **End** |
| **1.0** | **Senior Design Plan** | 210 | Jan. 9 | Dec. 3 |
|  |  |  |  |  |
| **2.0** | **Writing phase** |  |  |  |
| **2.1** | Initial Document | 8 | Feb. 7 | Feb. 14 |
| **2.2** | Half Final Document | 28 | Feb. 14 | Mar. 12 |
| **2.3** | Final EEL 4914 Doc | 30 | Mar. 12 | Apr. 20 |
| **2.4** | Final Document | 105 | Aug. 20 | Dec. 3 |
| **2.5** | Final Presentation | 105 | Aug. 20 | Dec. 3 |
| **3.0** | **Research Phase** |  |  |  |
| **ID** | **Project Name** | **Days** | **Start** | **End** |
| **3.1** | Hardware | 76 | Feb. 7 | Apr. 23 |
| **3.2** | Software | 76 | Feb. 7 | Apr. 23 |
| **4.0** | **Design Phase** |  |  |  |
| **4.1** | Sensors/Electronics | 69 | Feb. 14 | Apr. 23 |
| **4.2** | PCB Layout | 69 | Feb. 14 | Apr. 23 |
| **4.3** | Software(Comm.) | 69 | Feb. 14 | Apr. 23 |
| **4.4** | Ordering/Receiving Parts | 69 | Feb. 14 | Apr. 23 |
|  |  |  |  |  |
| **5.0** | **Assembly Phase** |  |  |  |
| **5.1** | Electronics Mounting/Soldering | 25 | Aug. 20 | Sep. 14 |
| **5.2** | Electrical Connections | 25 | Aug. 20 | Sep. 14 |
| **5.3** | Server/Software | 50 | Aug. 20 | Oct. 9 |
| **5.4** | GUI | 20 | Sep. 20 | Oct. 10 |
|  |  |  |  |  |
| **6.0** | **Testing Phase** |  |  |  |
| **6.1** | Microcontroller | 52 | Oct. 9 | Nov. 30 |
| **6.2** | Camera | 52 | Oct. 9 | Nov. 30 |
| **6.3** | Sensors | 52 | Oct. 9 | Nov. 30 |
| **6.4** | Navigation | 52 | Oct. 9 | Nov. 30 |
| **6.5** | Software | 52 | Oct. 9 | Nov. 30 |
| **6.6** | Whole Unit | 52 | Oct. 9 | Nov. 30 |