

Humber Parts Crib Database By: The Walking Programmers (Rafil Yashooa, Masoud Rahguzar, Divesh Oree) March 28th, 2017

Parts Crib Database

Project Website: [Masoud647.github.io](https://github.com/Masoud647)

Declaration of Joint Authorship

The work that is specified in this report is a joint project by Masoud Rahguzar, Rafil Yashooa, and Divesh Oree. The work that has been done is our own and is expressed in our own words. We have clearly defined all work cited using the APA format expressing the authors/owners and their information. All work in this project is equally divided defined in [section 2.4.4](#).

Approved Proposal

Technical Report for the development of Parts Crib DataBase

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Executive Summary

As students in the Computer Engineering Technology program, We will be integrating the knowledge and skills we have learned from our program into this Internet of Things themed capstone project. This proposal requests the approval to build the hardware portion that will connect to a database as well as to a mobile device application. The internet connected hardware will include a custom PCB with sensors and actuators for **Parts Crib Database**. The database will **store information of students who sign out items from the parts crib**. The mobile device functionality will include **list amount of each item in the parts crib and how many are left after being sign out and** will be further detailed in the mobile application proposal. We will be collaborating with the following company/department **Humber College Information Technology**. In the winter semester we plan to form a group with the following students, who are also building similar hardware this term and working on the mobile application with the following group members **Masoud Rahguzar, Rafil Yashooa and Divesh Oree**. The hardware will be completed in CENG 317 Hardware Production Techniques independently and the application will be completed in CENG 319 Software Project.

Background

The problem solved by project is it will improve the efficiency of students taking out items from the parts crib. This project will connect to a database and keep track of students with their full names, student numbers and items. There will be bar codes for each items in the parts crib that will be linked to the database that contains every item in the parts crib. When a student takes out items from the parts crib their card will be scanned with the items that are taken out. This will put the students in the list(database) of students who taken out items from the parts crib. This will intern keep track of all items taken out and help keep everything organized. The mobile application then will be used to list all the items available in the parts crib and will be available to all students in the campus. The mobile application will be presented in a listed form that will have detailed information of the items in the parts crib and help students know which item to take out.

We have searched for prior art via Humber's IEEE subscription selecting "My Subscribed Content" and have found and read which provides insight into similar efforts.(Bulan & Sharma, 2011; Deng et al., 2015; Muniz, Junco, & Otero, 1999)

In the Computer Engineering Technology program we have learned about the following topics from the respective relevant courses:

- Java Docs from CENG 212 Programming Techniques In Java,
- Construction of circuits from CENG 215 Digital And Interfacing Systems,
- Rapid application development and Gantt charts from CENG 216 Intro to Software Engineering,

- Micro computing from CENG 252 Embedded Systems,
- SQL from CENG 254 Database With Java,
- Web access of databases from CENG 256 Internet Scripting; and,
- Wireless protocols such as 802.11 from TECH152 Telecom Networks.

This knowledge and skill set will enable us to build the subsystems and integrate them together as our capstone project.

Methodology

This proposal is assigned in the first week of class and is due at the beginning of class in the second week of the fall semester. Our coursework will focus on the first two of the 3 phases of this project:

Phase 1 Hardware build.

Phase 2 System integration.

Phase 3 Demonstration to future employers.

Phase 1 Hardware build

The hardware build will be completed in the fall term. It will fit within the CENG Project maximum dimensions of 12 13/16" x 6" x 2 7/8" (32.5cm x 15.25cm x 7.25cm) which represents the space below the tray in the parts kit. The highest AC voltage that will be used is 16Vrms from a wall adaptor from which +/- 15V or as high as 45 VDC can be obtained. Maximum power consumption will be 20 Watts.

Phase 2 System integration

The system integration will be completed in the fall term.

Phase 3 Demonstration to future employers

This project will showcase the knowledge and skills that I have learned to potential employers.

The tables below provide rough effort and non-labour estimates respectively for each phase. A Gantt chart will be added by week 3 to provide more project schedule details and a more complete budget will be added by week 4. It is important to start tasks as soon as possible to be able to meet deadlines.

Labour Estimates	Hrs	Notes
Phase 1		
Writing proposal.	9	Tech identification quiz.
Creating project schedule. Initial project team meeting.	9	Proposal due.
Creating budget. Status Meeting.	9	Project Schedule due.
Acquiring components and writing progress report.	9	Budget due.
Mechanical assembly and writing progress report. Status Meeting.	9	Progress Report due (components acquired milestone).
PCB fabrication.	9	Progress Report due (Mechanical Assembly milestone).
Interface wiring, Placard design, Status Meeting.	9	PCB Due (power up milestone).
Preparing for demonstration.	9	Placard due.
Writing progress report and demonstrating project.	9	Progress Report due (Demonstrations at Open House Saturday, November 7, 2015 from 10 a.m. - 2 p.m.).
Editing build video.	9	Peer grading of demonstrations due.
Incorporation of feedback from demonstration and writing progress report. Status Meeting.	9	30 second build video due.
Practice presentations	9	Progress Report due.

1st round of Presentations, Collaborators present.	9	Presentation PowerPoint file due.	
2nd round of Presentations	9	Build instructions up due.	
Project videos, Status Meeting.	9	30 second script due.	
Phase 1 Total	135		
Phase 2			
Meet with collaborators	9	Status Meeting	
Initial integration.	9	Progress Report	
Meet with collaborators	9	Status Meeting	
Testing.	9	Progress Report	
Meet with collaborators	9	Status Meeting	
Meet with collaborators	9	Status Meeting	
Incorporation of feedback.	9	Progress Report	
Meet with collaborators	9	Status Meeting	
Testing.	9	Progress Report	
Meet with collaborators	9	Status Meeting	
Prepare for demonstration.	9	Progress Report	
Complete presentation.	9	Demonstration at Open House Saturday, April 9, 2016 10 a.m. to 2 p.m.	
Complete final report. 1st round of Presentations.	9	Presentation PowerPoint file due.	
Write video script. 2nd round of Presentations, delivery of project.	9	Final written report including final budget and record of expenditures, covering both this semester and the previous semester.	
Project videos.	9	Video script due	
Phase 2 Total	135		
Phase 3			
Interviews	TBD		
Phase 3 Total	TBD		
Material Estimates	Cost	Notes	
Phase 1			
Raspberry Pi 3.0(Kit), HDMI, Webcam, LED lights, PCB, Speaker	189		
Peripherals with cables			
Sensors			
Phase 1 Total	>\$200.00		
Phase 2			
Materials to improve functionality, fit, and finish of project.			
Phase 2 Total	TBD		
Phase 3			
Off campus colocation	N/A	N/A	
Shipping	25		
Tax	18		
Duty	N/A		
Phase 3 Total	43		

Concluding remarks

This proposal presents a plan for providing an IoT solution for Parts Crib. This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative IoT capstone project demonstrating my ability to learn how to support projects such as the initiative described by our group, Humber parts crib. We request approval of this project.

Abstract

The reason for this project is to develop a new parts crib system that is efficient and reliable, instead of the present way of using paper slips that are used to sign out items. The parts crib is an area that is used for technology students at Humber who can sign out hardware items that can be useful for labs and projects which is very useful. Our project will consist of three major hardware parts the Raspberry pi, webcam and barcodes. Raspberry Pi is the brain of the operation computing and processing all the actives in the parts crib. The webcam is the eyes of the operation by scanning the barcodes. Lastly, the barcodes hold the information to identify each item in the parts crib and students who take out items. All information will be fetched to a database that will categorized using firebase. The database will be working along with our app and website, these applications will be used for showing the inventory status of the parts crib. In addition, the applications will also be used for the administrator (individual who works at the parts crib.) whom will have additional options to manipulate the inventory status and the students who took out items. This is brief description of our project.

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1. References

Illustration/Diagrams

1. Introduction/Overview

The main point of this project is to create a new parts crib system that is more efficient and more advanced than just using paper slips to sign out item from the crib. What we have in mind for the project is to create a barcode scanner using either a web cam or either a laser scanner (if we can afford one) to scan student numbers and items that will be checked out by the students.

So, when a student comes to the parts crib for an item, they will be assigned a barcode with their student number if it's their first time coming and then they'll be ready for item take out. All the administrator has to do then is to scan the student number and then start scanning then items that that user requested as they will each have a barcode. After the scanning is done, the user is ready to go and their student number will be stored in the local database on the raspberry pi.

The barcode scanned will be processed by the Raspberry Pi which will store it on the SQL database and then the application fetches from the database and displays the information. Note: only administrators will be able to view the student numbers, regular users will only be able to view the inventory count of items in the crib.

2. System Requirements Specifications

The goal of this project is to create a better system for the Humber part's crib system. It is a more organized way of signing in and out items. This application is going to receive data from a Raspberry Pi that will be used as our hardware device located in the parts crib. The user has to first scan the student id and that is recognized by the first 'n' character. And then scan the part number which will be identified by a 'p' character. Every item that the user will scan will go under the student's name for check out which will go to a database stored in the raspberry pi.

This application is designed for an android device. This project also cannot work offline due to the database being a huge part of the hardware aspect. However, internet availability in the college is very static and will no need to be offline at anytime

2.1.1 Purpose

This project is a collaboration of the Humber Parts Crib which will allows students to sign off items for their labs on regular basis. Our main objective and goal is to make the Humber Parts Crib more effective by using cutting edge technologies.

2.1.2 Product Overview

The main product that we will be using is a Raspberry Pi 3, a camera, a well-designed PCB with the LEDs and speaker mounted on it. All of these component will be assembled inside a case for the safety and provide a better presentation of the project.

2.1.3 Targeted Audience Group

The main targeted audience group will be the students studying at Humber College, mostly in engineering programs. The administrator will obviously have to be a staff of the college in order to be able to use it. This device will allow students to sign parts much quicker and help us to reduce the usage of paper.

2.2 Product Information

2.2.1 Main Functionality

The functionality is pretty simple. Basically, we will have a camera which we will use in order to scan the barcode strip on the student card and that barcode information will be processed by the raspberry pi 3 and will get input electronically in the system. On the new custom made PCB, we will mount a speaker and the LEDs which will allow the user to recognize if the barcode got scanned successfully or not.

2.2.2 Extra Requirements

In order to be able to use the device and have access to the database web interface, it is important that we have internet connection as everything will be connected on a server. As an extra requirement, we might use an RF scanner (we are planning on discussing with our Professor first before moving forward) in order to speed up the scanning of barcodes.

2.2.3 Best Performance

As stated above, we will mount both the LEDs and the speaker on a newly designed PCB instead of having them connected separately. The LEDs will toggle a green light if scanning is successful and then red if unsuccessful. The speaker will produce a “beep” sound which will allow the admin to recognize whether the barcode got scanned or not. We also decided that we will consider designing, building a stand and attaching it to the case which will hold the student card in order to provide a best performance when it comes to scanning the barcode.

2.3 Overall Description

2.3.1 Database

For our capstone project this term, we are building a PartCrib system which hopefully be successful enough to be used by the Humber’s parts crib department. This project consists of 2 major parts, hardware and software. And in order to have the hardware interact with the software, we need them both to be connected to the same database so that one can send data and the other receive data, and vise versa.

The hardware part of this project is going to act as a scanner to scan barcode items and student id barcode. After it scan them successfully, the database would create a table for each student id it scans with a row of the exact time stamp and part number. Students would be able to sign out multiple items at once since the table can handle many rows under it.

The software part would be the project’s android application and it would retrieve data from the database and display it live to the application. The data it retrieves would be based on the user’s privilege, if it was

an administrator using the app, it would display the full database with the student numbers and part numbers. But if it was only a guest browsing the app, it would only display the inventory with the items available in stock to sign out.

For the database, we are going to be using an SQL based service, the database we have up and running right now is firebase which doesn't allow full access to retrieve data to the application. We are either going to find a solution for this or use an SQL server running on another computer which is going to be port forwarded from home.

2.3.2 Hardware

The Humber parts crib is a project that will be able to keep track of students who take out and return items from the crib. This will occur because of three main hardware components; the raspberry pi, a camera, and barcodes. The raspberry pi is basically single-board computer which will be the brains of the project by computing and keeping track of all the student's activity in the parts crib by using the code/program implement by us the developers. Secondly, the camera, an important hardware component because it will be used to scan items in the parts crib which then will be sent to the raspberry pi. Lastly, the paper barcodes will be used to identify the items in the parts crib when scanned by the camera. In addition, the Humber parts crib project will have additional hardware components such as LED lights to notify when an item is scanned or when it is unable to be scanned and there will also be a sound bar implementing the LED characteristics but with sound.

identified by a 'p' character. Every item that the user will scan will go under the student's name for check out which will go to a database stored in the raspberry pi.

This application is designed for an android device. This project also cannot work offline due to the database being a huge part of the hardware aspect. However, internet availability in the college is very static and will no need to be offline at anytime

2.3.3 Application

The application for the Humber parts crib is an interactive, simple and user-friendly app (available only on android) that has the potential of being very useful for students at Humber. The app will consist of two types of users, the first being the student user and the second being the administrator. The student users in the app will only have access to the inventory status of the items in the parts crib. The administrator users will have a username and password that will give them access to everything in the app such as inventory status, database, add items and delete items. The way the app will continuously update the inventory status is by the use of a database program called firebase.

2.3.4 Database with Web Interface

For our Humber Part Crib project, our web interface will be designed using a two-tier architecture where the administrator will communicate and interact with a server. The web application will be based on a Java platform where it will communicate directly with a firebase database by using the appropriate Java Database Connectivity API. The latter will use his credentials that is his email address and password in order to log in. Inside the database, the administrator will have the privilege to check all the items available in the inventory, remove a student once the items have been returned, and also add a new student with the item parts which are being signed out from the crib.

As the database, will be connected on the Humber Server, we expect the wireless internet connection to be fast enough and is connected to the right access point so that the administrator can perform his daily task without any difficulty and hence making this whole project an effective one.

2.4 Future Considerations

2.4.1 Operating Environment

In order to be able to use this device, you will need a system which is connected to a rapid internet connection.

2.4.2 Safety Considerations

Safety precautions to take into consideration:

- Protect the device from any liquid exposure and always wear safety glasses
- Check your connections first before powering the raspberry Pi
- Always have your username and password , in order to have access to the database web interface
- Remember to sign students off after they return the parts in order to avoid database stack overflow

2.4.3 Future Additions

We might consider on designing and cutting out a new acrylic case as the previous one that we made was a bit too big. Also, as mentioned above regarding the RF scanner, we will make the stand first and see how it works.

2.4.4 Workload Breakdown

The work break down will consist of three sections the first is the database, the second is the hardware and the last section is software. Rafil Yashooa will be responsible for the database which he will connected to the website application and the hardware to work seamlessly together. Masoud Rahguzar will be responsible for the hardware, printing a PCB which will connect the speaker to the Raspberry Pi, Acrylic case using corel draw and many other aspects in the hardware. Lastly, Divesh Oree will be updating and improving the mobile application for inventory use.

2.5 Build Instructions

2.5.1 Introduction

This build log instructions will help students replicate our project for future use, We will describe and show step by step instructions on how to do so. The group members who participated to create this project are Masoud Rahguzar, Rafil Yashooa, Divesh Oree and felt like it was their duty to make a better system to take out parts from the parts crib.

The main point of this project is to create a new parts crib system that is more efficient and more advanced than just using paper slips to sign out item from the crib. What we have in mind for the project is to create a barcode scanner using either a web cam or either a laser scanner (if we can afford one) to scan student numbers and items that will be checked out by the students.

So when a student comes to the parts crib for an item, they will be assigned a barcode will their student number if its their first time coming and then they'll be ready for item take out. All the administrator has to do then is to scan the student number and then start scanning then items that that user requested as they will each have a barcode. After the scanning is done, the user is ready to go and their student number will be stored in the local database on the raspberry pi.

2.5.2 System Diagram

The humber parts crib database project functionality is to be able to scan barcodes on student id cards and the associated part items from the parts crib and then be placed in a database. Now understanding what the concept of the humber part crib database project is, the system diagram can be easily interpreted.

Figure 1: systemdiagram

Image 1: This picture displays the system and how it works

2.5.3 Bill of Materials/Budget

The main materials/components required for our project are a raspberry pi, webcam and barcodes. Added features/materials are PCB for light indicator, sound bar and acrylic box. The PCB and acrylic box were both provided by the school. In addition, the raspberry pi requires a monitor, keyboard and mouse to be setup. Our budget was fairly simple and not expensive except for the raspberry pi kit. Our full excel version of our budget is provided in our GitHub page.

Item	Site/Provider	Price (Including Tax)
Raspberry Pi 3.0 (Kit)	Amazon.ca	\$135.99
HDMI	Bestbuy.ca	\$15.99
Web-camera	Amazon.ca	\$19.99
Web-camera 2	Canada Computers	\$76.01
Barcode Strips	Barcodesinc.com	\$4.99
Acrylic Box	Humber College	\$15.00
PCB	Humber College	N/A
LEDS	Amazon.ca	\$2.00
Total:		\$264.97

~ Budget

Image 2: This picture displays the budget in a excel format

2.5.4 Time Commitment

The time commitment for our project took about 15 weeks to complete in its entirety. Firstly, the project began with ordering parts through websites like amazon, eBay and all sorts of technology base websites. Once ordered, the delivery took about week and a half (week 2 & 3) to come in. As everything arrived, we then began to setup our Raspberry Pi and all of its components which took about 1 hour to setup. As week 5 approached we printed out the PCB and started soldering everything. The soldering approximately took me about 2 hours to complete at school. Afterward, at week 6 and week 7 we started to test the raspberry pi and its components which took us about 6 hours in its entirety. Firstly, we tested if the PCB by implementing the code given by the teacher that can test if the lights work and the sensors. Then we started implementing the code in which will scan barcodes with our webcam which then again took me about 5 hours to complete. Next, during week 9 we created the remote desktop with the raspberry pi and laptop so we could connect it remotely without using an external monitor, keyboard and mouse. Lastly, during week 12 and 13 we began and created our acrylic box, the box design took about 1 hour to complete and the laser cut took about 20 minutes. Here at the bottom is all the task we completed and will be easier to understand.

Time Commitment Schedule:

Tasks	Time Required
Ordering Parts & Delivery	2 Weeks

Raspberry Pi Setup	1 hour
PCB Soldering	2 hours
Testing PCB	1 hour
Coding	5 hours in span of 4 days
Remote Desktop	1 hour
Mechanical Assembly	15 minutes
Designing acrylic box	2 hours
Laser Cutting	15-30 minutes

Table 1: Display time commitment in a table format

2.5.5 Mechanical Assembly

The assembly of our project is very simple first connect the PCB on top of the raspberry pi which contains the light indicator. Secondly, proceed and connect the webcam to the USB port on the raspberry pi and then lastly connect the raspberry pi to a power outlet. And that's how to Assembly all the parts of our project.

2.5.6 PCB / Soldering

Humber college provided us with a PCB which is called the Modular Sensor Hat. The PCB contains 20 pin GPIO header, two 4 pin header, 5 pin header, a couple of resistors, transistors and a light. Before soldering, we took care of safety by wearing safety glasses and make sure the workplace is clear. The soldering was fairly simple to complete because of the schematic which outlined where everything goes.

Figure 2: PCB

Image 3: Displays the PCB and all its glory

Easy Steps to follow

When you start up a Raspberry Pi, you should always start with updating it by using these commands: `sudo apt-get update` and `sudo apt-get upgrade`.

You'll want to do this as your Raspberry Pi will get the latest patches and updates from the developers.

First of all, you'll need to install python and the python/zbar library using the following commands:

```
sudo apt-get install python-dev
```

```
sudo apt-get install python-pip
```

Next, you'll need to install pillow

```
sudo apt-get install python-pip
```

```
sudo apt-get install python-httpplib2
```

After, go ahead and download the zbar library from this github account:[Here](#)

Click on "Clone Or download" and you should see it start downloading

After that, use the `unzip` command to extract the folder and the `cd` into the folder.

After you're in the folder, execute the following command: `python setup.py install --user`

If everything was done right, you should get no errors and the files should be extracted.

After that, use the code that that is provided in the downloads bellow and download all the downloads as they all link to each other.

After downloading all the files, you'll need to compile the `red_light.c`, `green_light.c` and also `softTone.c`

Compiling them using: `gcc -Wall -o executable name c_file.c -lwiringPi`

Where 'executable name' is the name of the executable you'll want them to be, 'c_file.c' is the source file. NOTE: make sure the executable names are the same as the ones in the bar_code.py file as they will be called from there.

If everything is done right, you should be able to run and scan a barcode, when it successfully scans the barcode, you should notice the light turning green and the beep audio sound coming from the speaker, after it scans it, you should be able to see the created file called student_number.txt which will contain the stored student numbers.

2.5.7 Unit Testing

The uniting testing begins the PCB as mentioned in the power up. It is recommended to use the code that is given by Humber College or at the GitHub page to test if the light indicator works. The light indicator can work with the command "`sudo ./traffic2B`" if the code is there. The next step is to check if the webcam work. This can be done by installing FSWEBCAM by putting "`sudo apt-get install fswebcam`" in the command line of the terminal which will install an easy way to check if the camera works. Once installed type "`fswebcam image.jpg`" in the command line and if it takes a picture with good quality the webcam works. After this, the code created for this project can be used which is in the GitHub page. The program can run by typing "`python bar_code.py`" in the command line.

2.5.8 Production Testing

The production testing is fairly simple. Run the barcode program bar_code.py and place a barcode in front of the webcam. In addition, focus the webcam (manually if needed) so that it can quickly scan the barcode. Once scanned the barcode will be place in a txt file and in the terminal it can display the txt file by typing for example "`cat nameoftxt.txt`".

Downloads:

All the downloads will be posted under my github page:

Source Files: [Here](#)

2.6 Progress Reports

Progress Report

At this moment on week 4, we are supposed to handle in our progress report stating the progress of the whole project. On Week 2, we submitted our proposal and port it into Markdown and the two relevant pages printed out, the one with the inline citations and one with the references list. On week 3, we submitted our SRS (Requirement specification) which included the following sections:

1. Hardware present
2. Skeleton with SRS completed
3. Database and work breakdown
4. Application and work breakdown
5. Web and web breakdown

As of week 4 we are all on track according to our project schedule, we have started working on the web application for our project, the application is connected to a firebase server and currently has the functionality of fetching live data from the database. The application has 3 main functionalities, 'sign out item' which lets the administrator scan student ids and the part numbers. A 'Return Item' which lets the administrator scan or manually input the student id and then ability to return parts all at once. And

finally a 'View database' button which lets the admin access the full database with all the current holdings, it also tells you the number of people that have items signed out in total and a search option which is a work of progress as of right now. The application was build using HTML, JavaScript and JSP for the login credentials.

As for the problems we encountered, the search option still does not work properly, it only displays the last item in the database list and doesn't find a result for the entries above. I'm hoping to fix sometime tomorrow or at the end of this day. The next step is to insert data from the raspberry pi into the database and then after, fetch that data and use it for the following functionalities.

We have not exceeded our financial status as our project consists of only programming for this stage.

Links to the web application: <http://munro.humber.ca/~no1040349/>

3. Conclusions

The project, Humber Parts Crib has been created to keep track of all items in the parts crib when items are lent out and returned back. The Humber Parts Crib consists of a camera, raspberry pi, PCB (speaker & lights) and a case. This project intern will be able to scan barcodes representing the students and items. The data will be placed in a database called firebase using the website application which will be fetched by the mobile application. The mobile application will be able to display the inventory status of the parts crib, helping students determine if there is an item they want in the parts crib. The website application will contain the administrative tools/control to be able to lend out and return items which will be used by the employee at the parts crib.

4. Recommendations

Throughout the creation process of our project there are recommendations that could be made if reproduced again. The first being the web camera, having a better web camera will help accelerate the speed at which barcodes are scanned, thus increasing the performance. In addition, having small web camera can allow for a smaller and compact case which can be much portable if need.

5. References

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