By

PROGRESS REPORT IV FOR EE & CS STUDENTS

Version 1.0

TEAM 7

February 17, 2012

Görkem Çakırhan	(HW)
Ceren Canpolat	(SW)
Alper Günçal	(HW)
M.Ali Yıldırım	(MAN)
Fatih Şahin	(IE)

Table of Contents

1 Introduction

1.1 About this Document and to Its Readers

Progress Report IV is a document that is written for planning the second semester. It divides the whole work into workpackages. Detailed description, start time and finish time of each workpacgake is included in this Progress Report IV. It also includes a test plan, which describes the final demonstration of the product, its functionality and requirements. An updated version of Product Specification document is also included at the end of Progress Report IV.

2 Detailed Plan of the Second Semester

To be able to plan this semester's work, we divided the whole work into subparts so that we could see all the necessary actions need to be taken beforehand.

2.1 Workpackages

The work we need to do in order to complete the product has been divided into eight parts. Which are implementing communication between control point and bag dispenser, testing the communication protocol, designing the mechanical part of bag dispenser, integration and test the internal structure of bag dispenser, control point's mechanical design and test of it, registration of cash registers sale files' names to the system, filling database and testing the software for more than one cash register. The description of these workpackages are as follows:

WP1: Implementing communication between control point and bag dispenser

Two distinct devices, the control point and bag dispenser, should communicate with each other. Since there is distance between them, connecting the microcontrollers' pins directly to each other doesn't work properly. So a protocol should be used to handle this problem. Ethernet protocol can be used for this purpose, but then a new problem may occur: interfacing

Ethernet to the 8951 microcontrollers that we use. To encounter those problems, we may use a new type of microcontroller, which has on board Ethernet capability. Our engineers are working on those problems to solve in the most efficient manner and they are in contact with Prof. Ezhan Karaşan to help us handle this problem.

WP2: Testing the communication protocol

After implementing the communication protocol, it should be tested for different distances that we may encounter in markets. It should work properly for distances 10 cm to a few meters.

WP3: Bag dispenser mechanical design

Design of the dispenser's mechanical part is an important workpackage. There is more than one issue in this part.

1) Design of connection between the motor and the roll:

2) Design of part that the bag roll would be put: When the dispenser run out of bag, it should be easy to replace with a new roll. So that the mechanical design of this part should be done concerning this issue.

WP4: Integration and Test of Bag Dispenser's Internal Structure

After bag dispenser's mechanical design completed, the DC motor, 8951 microcontroller, infrared sensor and the bag roll would be placed in the product. Dispenser will be tested to be sure that all components are working properly with each other.

WP5: Control point's mechanical design and test

It would contain an input port which takes the data that comes from the main computer and 30 output ports which are used to send the evaluated data to the appropriate bag dispenser. Its working principle is like a simple switch and it would be designed as a rectangular box to place the input and output ports and microcontroller in it. It will be tested to be sure that the

data that comes from the main computer is correct and correct data is sent to the bag dispenser's microcontroller correctly.

WP6: Registration of Cash Registers Sale Files' Names to the System

In supermarkets there is a computer where all sales files of cash registers are recorded. These files are located at different locations, therefore our software program should know all those places in order to learn which products have been bought and notify the LessBag about which cash register needs the bag. Since these locations cannot be foreseen by engineers, there should be a file which will be written by customer indicating where the cash registers' sales files are located. Since this file requires a task which will trigger the initialization process of our software program, there should be a task which will read this file and take the necessary action accordingly.

WP7: Filling Database

In database there should be at least 25 products (each type at least will have 5 products) so that correctness of the algorithm can be understood easily. These products should be entered into database with all necessary information such as type, mass and volume.

WP8: Testing the software for more than one cash registers

In last semester our software was working with the assumption that only one cash register will exist in a supermarket and the test was done accordingly. However in this semester since the software will be changed to cope with more than one cash register the testing of it need to be done again with different constraints. Simultaneous working of cash registers and the performance of LessBag need to be checked.

2.2 Test Plan

In the test plan, we plan to show that the following tasks are working correctly:

- Task1 should be able to reach and read the sale file and give the barcode number and cash register number to Task 2.
- Task2 should be able to get the product information (type, mass, volume) that corresponds to the barcode number's row at the database and give that information to Task3.
- Task3 should be able to determine if a bag-roll request need to be sent to Task4 in order to start serial communication with control point.
- Task4 should be able to get the bag roll request of dispenserX from Task3 and send it to control point's microcontroller with serial communication.
- Task5 is to take the correct data which contains the number of the bag dispenser via the serial port to control point and give the bag from the correct dispenser. We will use Ethernet communication to send the correct data from the control point to the correct dispenser.
- Task6 is to give exactly one bag to the customer by using the infrared sensor when one bag request comes from main computer via control point.
- Task7 is to use 1 bag button to give a bag by the cashier whenever any customer needs a bag.
- Task8 is to give the bag less than 1.3 seconds and avoid the bag to roll down when the customer pulls the bag from the dispenser. The system would not be locked when the customer pulls down the bag but there would be enough opposing force to stop the bag from rolling.

2.3 Time Table

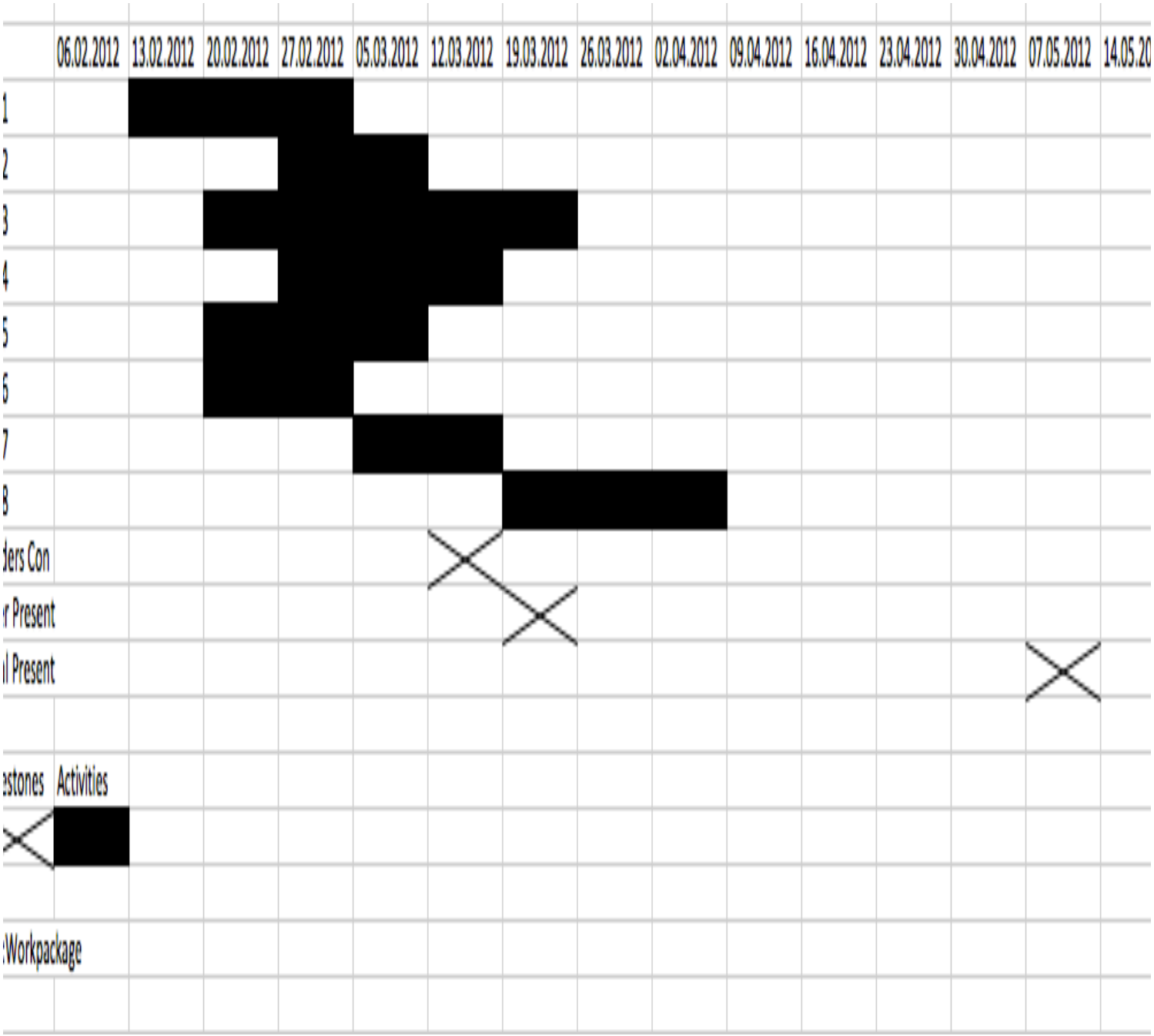


Figure1: Time Table

3 Conclusion

In conclusion, throughout the documentation, defining the workpackages provided us the ability to see the whole project in its subparts. This new point of view enabled us to see the possible conflicts that may occur within the timetable if things did not go perfectly, and with this information we programmed ourselves accordingly. Additionally, while we were preparing the test plan we saw our priorities and ordered the workpackages by their importance.

4 References

1. “Test Plan” < http://en.wikipedia.org/wiki/Test_plan>
2. ”System Requirements” <http://en.wikipedia.org/wiki/System_requirements>
3. “Schedule Relaxation”

   <http://systems.cs.columbia.edu/files/wpid-peregrine-sosp11.pdf>

5 Appendix

PRODUCT SPECIFICATION DOCUMENT

GE 401

PRODUCT SPECIFICATION DOCUMENT

Version 1.0

MORE MONEY

16.02.2012

Table of Contents

1 Introduction

1.1 Purpose

LessBag is a product that is designed for markets to help them reduce their bag consumption. It will be placed near each cash register in the markets, and will give exactly required number of bags to the customers. It will calculate required number of bags by analyzing the products that the customers buy, by checking their mass, volume and type.

1.2 About this Document and its Readers

The Product Specification Document describes what the project is to do in terms of measurable constraints. There are 3 fundamental roles of this document:
1) It is an input for the developer company's engineering department since it contains the project requirements with measurable specifications.
2) At the end, this document will be used to check the product, to see if it does everything that it should be as written in this document.
3) It helps the engineers to divide the problem into pieces.

2 System Requirements and Constraints

2.1 Electrical Characteristics

- The product would work with 220V AC power supply which is the industry standard in Turkey.
- The current drawn by product would be at most 250mA under maximum load (while the dispenser is rolling down a bag), and at most 20mA in standby condition.
- If the product requires DC voltage, the user still should not be forced to use DC power supply. It will be done by product either by regulating the AC voltage to DC in the product, or out of the product by adapter.
- In supermarkets, the system should support up to 30 dispensers.

2.2 Mechanical characteristics:

- Weight: 5kg
- Volume: 35cm x 25cm x 20cm
- The dispenser will use rolled bags. The dimensions for big rolled bags are 30x55 cm. The machine will be designed for bags that have 30 cm width. There are also other sizes of bags are available in the markets. The dispenser would be compatible with those sizes, which are: 25x46 cm, 22x40 cm.
- The bag dispenser should be capable of rolling-down 1 full bag at most in 1.3 seconds. The dispenser should be 1 meter above the ground so that customers can easily take the bags.
- The color of the dispenser would be green because the product should seem as nature-friendly.
- There should be some messages written on the dispenser such that the customer will ashamed of demanding one more bag from cashier. One of the examples to those messages can be: “Save Earth! We have nowhere else to go!”
- The noise level of the product would be less than 60dB.
- The response time of the product is at most 500ms. (By response time, we mean the time from starting the calculation to starting to roll down the bag)

2.3 Software Characteristics

Time Requirements: Since LessBag need to be fast in order not to wait the customer time requirements for each task has crucial importance. Time requirements are as following:

- Reading the file in order to get the barcode number of product should not take more than 50 milliseconds since reading the file can cope with this time constraint this task can accomplish its time requirement in time.
- Retrieving the product information from database should not take more than 100 milliseconds in order to make the bag-roll decision faster. This is easy to achieve if main computer’s hard disk’s seek time and rotational latency are low enough and its ram should have enough space.
- Algorithm which will make the bag-roll decision should not take more

than 50 milliseconds since the code for it is not that long this decision duration will achieve this time constraint.

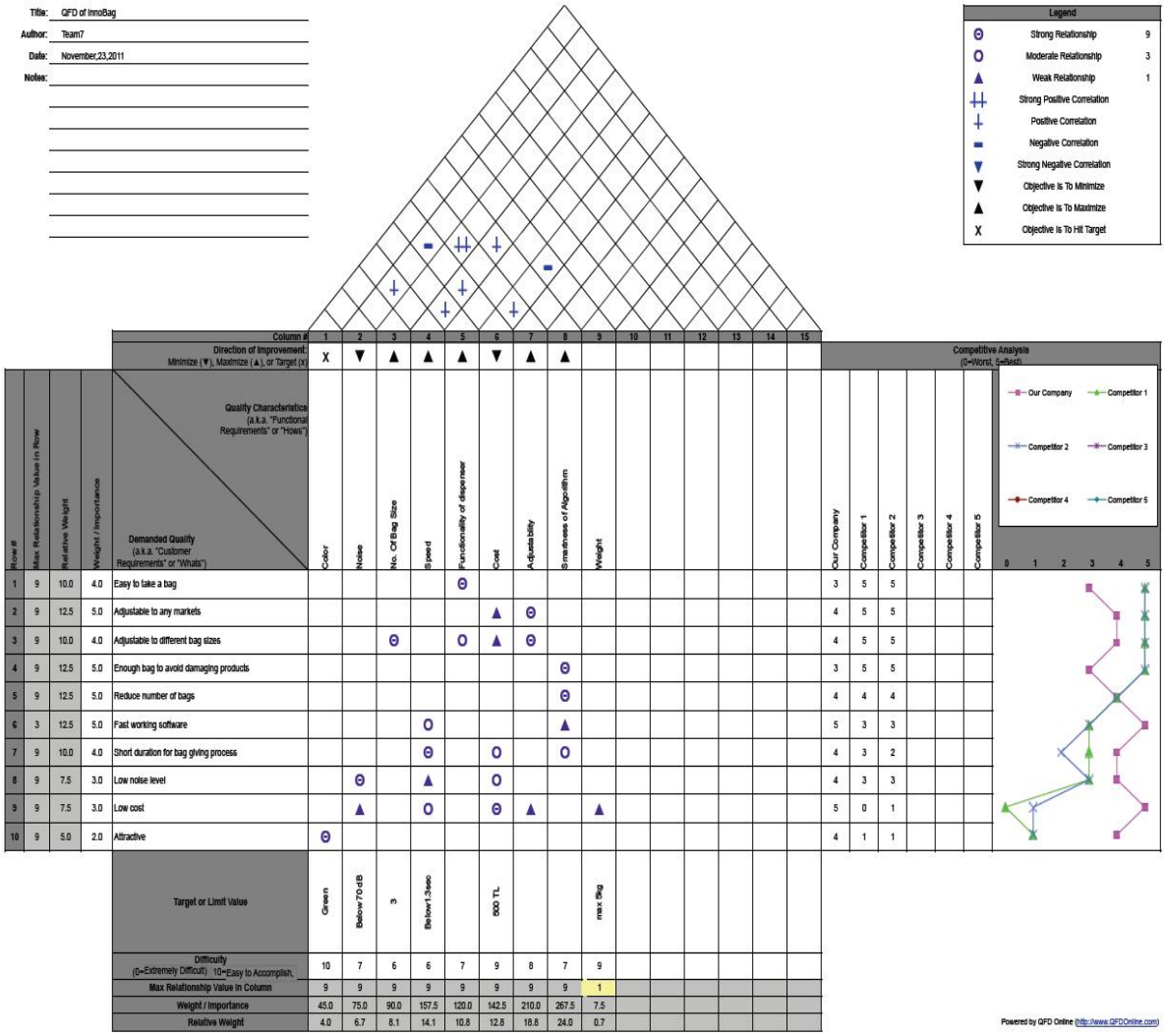
- Serial communication should not exceed 10 milliseconds in order to satisfy the general system's time constraint. Since the baud rate is the number of times the signal can switch states in one second, if we operate at 9600 baud, the line can switch states 9600 times per second. This means that each bit has the duration of 1/9600 of a second. This corresponds to 100 microseconds. Since we will send at most 40 bits, the duration will be at most 4 milliseconds.
- Sending a 1 to 0 transition signal over a wire should not take too much time. Therefore in 10 milliseconds this task can be and should be completed.

Space Requirements:

- The space for task one is simply the size of sale file, this file's size depends on the shopping has been made therefore it cannot be interfered. However if we assume that there can be at most 30 products in one shop the size of the file can be at most 18KB.
- The space required for database should be large since there are thousands of products recorded inside it. The total space it should use should be at most 100KB for 1000 products.
- The space for the decision algorithm should be small because the algorithm has not uses too much space already. However we can say that it should not exceed 5KB.
- Only space this task can use is the memory of microcontroller of the control point. Since we will store the serial data in order to coping with very fast rolling down requests, the microcontroller which has memory of at least 2K will be enough for us.
- Since this task only sends an interrupt signal it has no space requirements.

3 QFD

The House of Quality Matrix is as follows:



Color: There is a strong relationship between color and attractiveness. We want the customer to feel that they save the world by using LessBag. By considering this, we choose the color to be green because we think green color is related with being nature friendly. The difficulty of this specification is rated as 10 where difficulty ranges from extremely difficult (0) and easy to accomplish(10).

Noise: There is a strong relationship between noise and low noise level, and a weak relationship between noise and low cost. Customer wants to have low noise level but at the same time they wanted it to be cheap. Since the relationship between low cost

and noise level is weak, without thinking so much about cost (since it will not effects much), we decided the product should have noise level below 70 dB. This level is chosen considering the cashier and the customers of supermarkets so that they wouldn't be disturbed. The difficulty of this specification is rated as 7.

Number of bag size: There is a strong relationship between number of bag size that the machine will support and adjustability to different bag sizes demand. The product should be designed to support different sizes of bags, as it's demanded by customer. The research that we made showed that there are three sizes of bags that are widely used in supermarkets. Those sizes are: 30x55 cm, 25x46 cm, 22x40 cm. The product will support those three sizes of bags. The difficulty of the specification is rated as 6.

Speed: Engineering speed constraint is related with 4 of customer demands: fast working software, short duration for bag giving process, low noise level and low cost. There are strong relationships between speed and both fast working software and low cost. There is a moderate relationship between speed and short duration for bag giving process. And finally there is a weak relationship between speed and low noise level. Without increasing the cost, the product should be work as fast as possible. Considering those demands, we choose that the machine should give the bag in less than 1.3 seconds. This will not require the fastest motors and microcontrollers in the world so it will not increase the cost, also it will not increase the noise level a lot. And to do this, we will have to create fast working software which is good because it is another demand of customer. The difficulty of this specification is rated as 6.

Functionality of dispenser: There is a strong relationship between functionality of dispenser and easy to take a bag demand of customer, and there is a moderate relationship between functionality of dispenser and adjustability to different bag sizes. The dispenser would be 1 meter above ground so that the customer will take a bag in a very comfortable way. We decided to let the customer take the bag himself, the product will not have a bag-cutting feature because the machine have to be adjustable to different sizes of bags, the cutting feature could be difficult to work correctly when the company changes the bag sizes that they use. The difficulty of this specification is rated as 7.

Cost: Cost is related with 5 of customer demands: adjustable to any markets, adjustable to different bag sizes, short duration for bag giving process, low noise level, low cost. There is a strong relationship between cost and low cost. There is a moderate relationship between cost and both short duration for bag giving process and low noise level. And finally there is a weak relationship between the cost and both adjustable to any markets and adjustable to different bag sizes. The company wanted to earn the money back that they spent on this product, in approximately 1 year. Our research showed that according to company demands, the price of this product have to be approximately 500 TL. The design should be made considering this price. The difficulty of this specification is rated as 9.

Adjustability: There is a strong relationship between adjustability and both adjustable to any markets and adjustable to different bag sizes. There is a weak relationship between adjustability and low cost. The product should be designed considering industry standards so that that, any company will buy and easily plug in it into their markets. Also it supports three different sizes of bags, and those bags are also industry standards. The power supply will also be chosen such that, without need of anything, customers should plug into standard 220V power supply and use the product. By doing those, the low cost demand of the customer wouldn't be forgotten. The difficulty of this specification is rated as 8.

Smartness of Algorithm: Smartness of algorithm is related with 4 of customer demands: enough bags to avoid damaging the products, reduce the number of bags, fast working software and short duration for bag giving process. There is a strong relationship between smartness of algorithm and both enough bag to avoid damaging products and reduce number of bags. There is a moderate relationship between smartness of algorithm and short duration for bag giving process and there is a weak relationship between smartness of algorithm and fast working software. The algorithm that will be used to calculate the required number of bags should be designed such a way that the number of bags used should decrease. On the other hand, it should not give less than enough bags, otherwise the products would be damaged. It should really

know the consumer's packing behavior and give bags according to those behaviors (for example no one would pack hygiene products with foods). The calculation process shouldn't be too long, because we do not want the consumers to wait too long near the bag dispenser to take a bag. The difficulty of this specification is rated as 7.

Weight: There is only one demand for this requirement which is low cost. The weight of the product would be in a way that will decrease the product's price. This somehow means, none of the engineers should try to decrease the weight of the product by using some better materials that would have less weight but more expensive. No, this shouldn't be done! The weight is not so important for companies that will buy the dispenser; there is only an upper limit which is not a low value, 5kg. Its weight should be anything below 5 kg, whatever minimizes the production cost. The difficulty of this specification is rated as 9.

The correlation between the engineering requirements is as follows:

- Number of bag size and adjustability have strong positive correlation because different number of bag size should be used to increase the adjustability of the product.
- Noise and speed have positive correlation since increasing the speed of the product can cause high noise levels.
- Speed and cost have positive correlation because speed increment requires powerful engine and it increases the cost.
- Cost and adjustability have positive correlation since making the product adjustable to many different conditions increases the cost.
- Speed and smartness of the algorithm have positive correlation. The algorithm can increase the speed of the product by working efficiently.
- Noise and cost have negative correlation. Trying to decrease the noise level can cause high cost levels.
- Cost and weight have negative correlation since decreasing the weight of the product increases the cost.

4 Conclusion

Consequently, the main aim of this document is to specify the requirements of the product in an engineering format. The product can be easily designed by engineers who use the measurable specifications in this document. The document specifies the electrical and mechanical characteristics of the product in more detail with specific values and it also specifies other requirements which are noise level, color and cost of product, adjustability and so on with measurable statements.

5 References:

4. Harvard Business Review. “The House of Quality”.June 1988. <http://www.csuchico.edu/~jtrailer/HOQ.pdf>
5. “Tek Kullanımlık Sarf Malzemeleri”.< http://www.tekkullanimlik.gen.tr/rulo-manav-market-hisir-poset.html>
6. Electric Motors. < http://sawdustmaking.com/ELECTRIC%20MOTORS/electricmotors.html>
7. Saint-Gobain(Performance Plastics). “Reducing Noise and Vibration in Electric Motors”. October 2010.< http://www.bearings.saint-gobain.com/news_detail.aspx?id=241466>