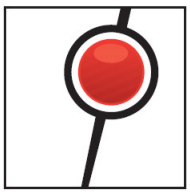

İstanbul
Bilgi Üniversitesi
LAUREATE INTERNATIONAL UNIVERSITIES

Istanbul Bilgi University

Laureate Bilgi Robotic Competition

BASTION THE SENTINEL

Park Cleaner Robot

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Contents

1 Scope

In today's era consuming is essential for human beings. This "consuming" leads to wastes which is a danger for mother nature. it leaves great amount of damage to the nature. Thus, there is huge space to fill for recycling and **Bastion The Sentinel** will help to close the gap. We are aiming for people to not waste their time for garbage collecting and separating for recycling from the beginning. The purpose of creating this robot is reducing manpower in collecting garbage and increase recycling to make future better.

Figure 1: Perspective capture of the **Bastion The Sentinel**

2 Device Functionality

Bastion The Sentinel is designed as a semi-autonomous robot. It will be a multi-tasking robot and it has two main parts. First part is movement controls and the second part is collecting garbages via image-processing. In addition to image processing abilities it can also be controlled by an operator. In the image processing part first it will consider color, if it is not successful it will perform image processing for the shape ofkm the object. It will separate all of the garbage by particularly and put them into box which is placed on top of the robot. After that operator will do separation. If there are one or more objects to collect, operator can change the box's volume and decide the count of separators. There could be obstacles around or unfavorable weather conditions like rain, snow, etc. Therefore some incidents are inevitable. Because of this top of the box can be closable.
For increasing the maneuver ability, we placed steering wheels to the back, besides we choose to place impulse to the front of the robot. The reason for choosing this method is while its collecting the garbages on the back, it will increase the weight because of that giving impulse in front will be more reasonable.
Another significant thing is deciding the sensors. We will use a proximity sensor for our robot. This way it will understand if its approaching to an object or not. In addition to proximity sensor we will use depth sensor for calculating the depth.

3 Overall Design Scheme

The block diagram which represents the overall system design is shown below

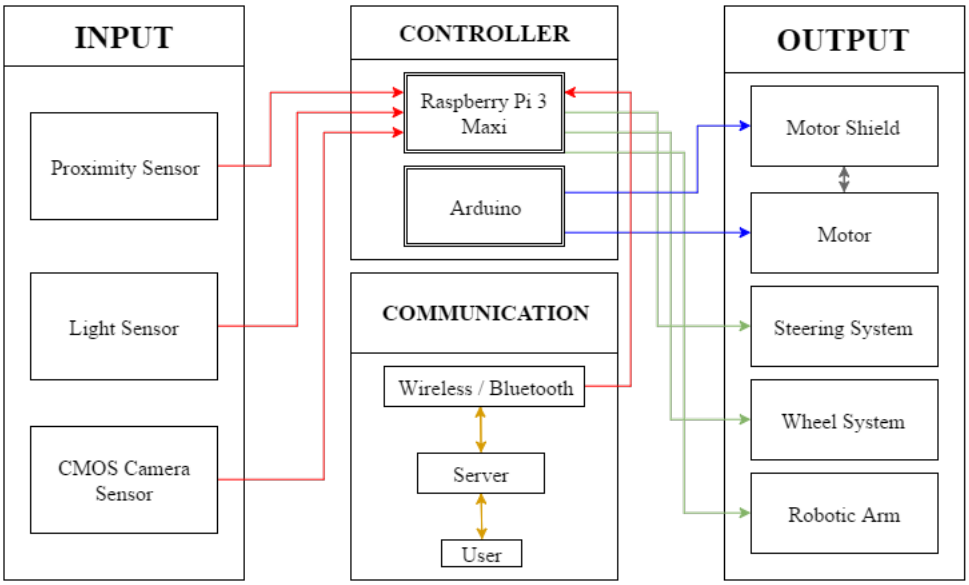

Figure 2: Block diagram of the system

The overall system of **Bastion The Sentinel** consists of 4 main blocks: input block, controller block, communication block and output block.

4 Details of Design

4.1 Input Block

Bastion The Sentinel will collect data from environment via its sensors and cameras. These data will be used to feed micro controllers. The main points are:

- **Bastion The Sentinel**'s robotic arm divided by three joints and has one gripper.
- Robotic arm can rotate 360° and it can be collapsed to minimize the area. Also the gripper part will have the ability to rotate up to 180°.
- Garbage detection is reinforced by proximity sensor. It will provide information about whether there is an object around of the robot.
- Depth sensor will be used to verify incoming data's from proximity sensor. If they match the robotic arm will start the collecting process.

4.1.1 Cameras

Visual information will be taken from the (CMOS Camera Sensor)cameras. The robot has led lights which allows it to operate in the dark. Video informations will be taken from 3 different cameras, 2 of them will be placed in front and the other one will be placed on the back facing to box. We will use front cameras as depth sensors and vision cameras. They will have two mods and we can switch from one to another. Cameras will be connected to Raspberry Pi 3 and video information will be processed on the user side for performance issues.

4.2 Control Block

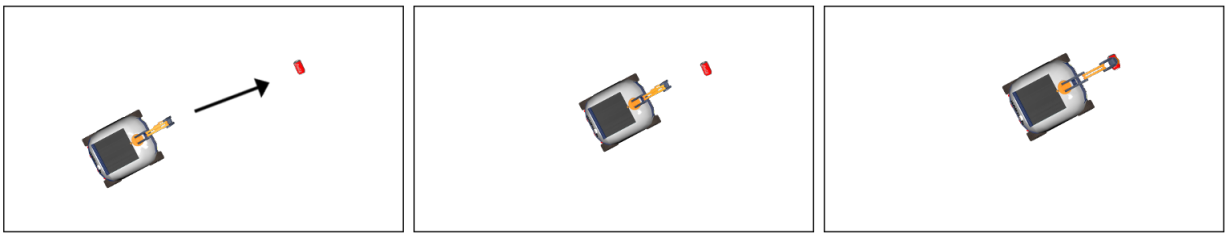

Figure 3: **Bastion The Sentinel** is approaching to an object.

In this block, Arduino (and Raspberry Pi) will manage the wheel system. It gives impulse to front wheels while it only rotates from back wheels. Two motor shields will drive four wheels.

4.3 Output Block

Micro controllers empower the DC motors for movement process on front wheels and also it empowers servo motors for rotating back wheels. After the data has been collected from the environment, micro controllers uses the robotic arm to gather objects to its container. All this information will be shared with the operator.
Bastion The Sentinel can use artificial intelligence to determine and separate the objects.

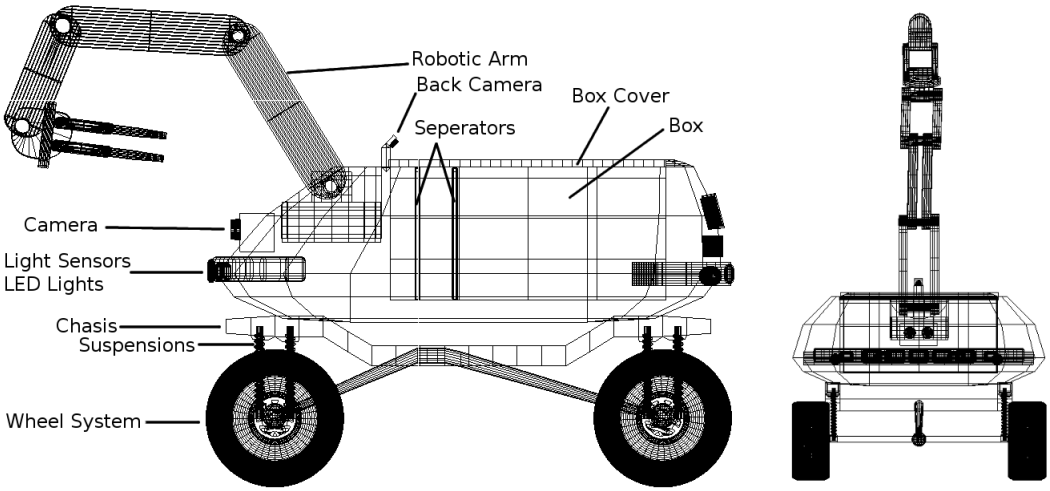

Figure 4: Mechanical design details (Side view and front view)

4.4 Communication Block

The communication will be provided via wireless connection which is on the Rasbperry Pi 3. Sensor information will be processed on the robot and will be sent to user. However, video data will be processed on the user side because of the efficiency. Our main goal is to provide simultaneous video transmission to grab objects in the best accurate way. We will be able to communicate with the cameras by Raspberry Pi 3's WiFi.

5 Time Table and Work Schedule

Task name	Start date	End date
Bastion: The Sentinel	23/09/16	17/04/17
Phase I	23/09/16	20/10/16
Submission Of the Entry Form	23/09/16	23/09/16
Reading Contest Documents	24/09/16	25/09/16
Research About The Topic	26/09/16	30/09/16
Brainstorm	01/10/16	04/10/16
3D Design	05/10/16	10/10/16
Logo Design	11/10/16	12/10/16
Selecting Components	13/10/16	14/10/16
Writing Proposal	15/10/16	19/10/16
Submitting the Proposal to Laureate	20/10/16	20/10/16
Phase II	21/10/16	17/04/17
Buying Needed Parts	21/10/16	29/11/16
Sensor Parts	30/11/16	08/02/17
Control Unit Parts	30/11/16	08/02/17
Prep. of Web Server & DB	30/11/16	08/02/17
Building The Body	09/02/17	28/02/17
Integrating Whole Parts to Body	01/03/17	12/03/17
Testing All Parts And System	13/03/17	01/04/17
Last Controls	02/04/17	16/04/17
Submitting The Video To Laureate	17/04/17	17/04/17

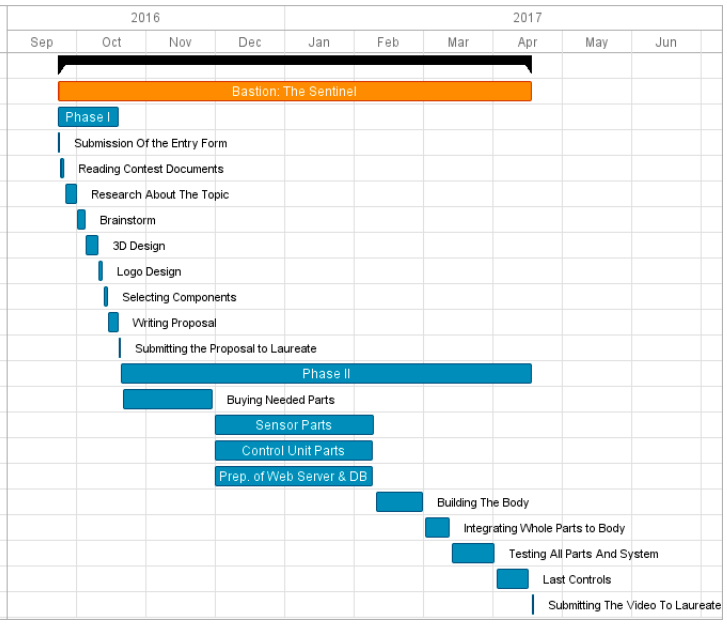

Figure 5: Time table and work schedule

6 CAD Design and Device Dimensions

Figure 6: CAD design, Approximate Dimensions: Length=50cm Width=45cm Height=40cm

7 Budget

7.1 Budget Breakdown

Materials				
Number	Material Name	Quantity	Unit Price ($)	Total Cost($)
	DC Motor	2	$30	$60
	Servo Motor	6	$8	$48
	Wheel	4	$15	$60
	Bearing Hub	4	$12	$48
	Carbon Fiber Chassis	1	$60	$60
	Upper Plexy Body	1	$45	$45
	Robotic Arm Components	1	$250	$250
	Shock Absorber	8	$15	$120
Kits				
-	Kit Name	Quantity	Unit Price ($)	Total Cost($)
	Raspberry Pi3 Maxi	1	$150	$150
	Arduino Mega Rev3	1	$40	$40
	Arduino Motor Shield	2	$15	$30
Sensors				
-	Sensor Name	Quantity	Unit Price ($)	Total Cost($)
	Proximity Sensor	1	**	
	Light Sensor	1	**	
	CMOS Camera Sensor	3	$40	$120
Communication and Internet				
-	Name	Quantity	Unit Price ($)	Total Cost($)
	Wireless	1	**	
	Domain Name	1	$25	$25
	Web expenses	1	$30	$30

*** indicates that Raspberry Pi 3 Maxi Kit includes this sensor*

7.2 Total Budget

The prices for the components of the **Bastion The Sentinel** are shown in the table.

- Base price: $1086
- Worst case scenario: $500
- Total: $1586

8 Safety and Environmental Sustainability

Bastion The Sentinel operates in a semi-autonomous way. It has a robotic arm and can interact with objects in environment. However, there can be living creatures or objects that we do not want to interact with. This situation creates a safety and security issues. Using the robot with an operator will be safest way to avoid these type of situations.

9 Business Plan

In Turkey, pollution rates are higher than other European countries. There are many researches for solving this problem. Yet there is not a proper way to solve it, however, our robot is the most convenient way to reduce the pollution problem. The purpose of creating this robot is to protect the nature and speed up the recycling process. It takes so many years for some materials to dissolve in nature. Also %75 of garbages are recyclable but %30 percent of it used used in recycling process. Moreover, if you leave recycling to nature, it will take years, that's why we thought that someone should step up and do something about it.