

**İstanbul
Bilgi Üniversitesi**

LAUREATE INTERNATIONAL UNIVERSITIES

ISTANBUL BILGI UNIVERSITY

LAUREATE BILGI ROBOTIC COMPETITION

BASTION THE SENTINEL

PARK CLEANER ROBOT

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1 Scope

In today's era consuming is essential for human beings, producing garbage every minute and 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 garbage collecting 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's separated in two parts. First part is movement controlling and the second part is collecting garbages via image-processing. In addition to image processing abilities it can also be controlled by operator. In the image processing part first it will consider color, if it will not be successful it will perform image processing for the shape of the object. It will separate all of the garbage by particularly and put them into box which is placed on top of the robot and operator will do separation. If there will be more than one objects are collecting, operator can change the box's volume and decide the count of separators. In the environment there can be obstacles or unfavorable weather conditions like rain, snow, etc. Therefore misfortune events can not be inevitable. According to this reason 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. On behalf of understand approaching an object we will use proximity sensor. In addition to proximity sensor we will use depth sensor for calculating the depth. **burda son kısma göz atmamız lazım cümleler güzel olmamış sanki**

3 Overall Design Scheme

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

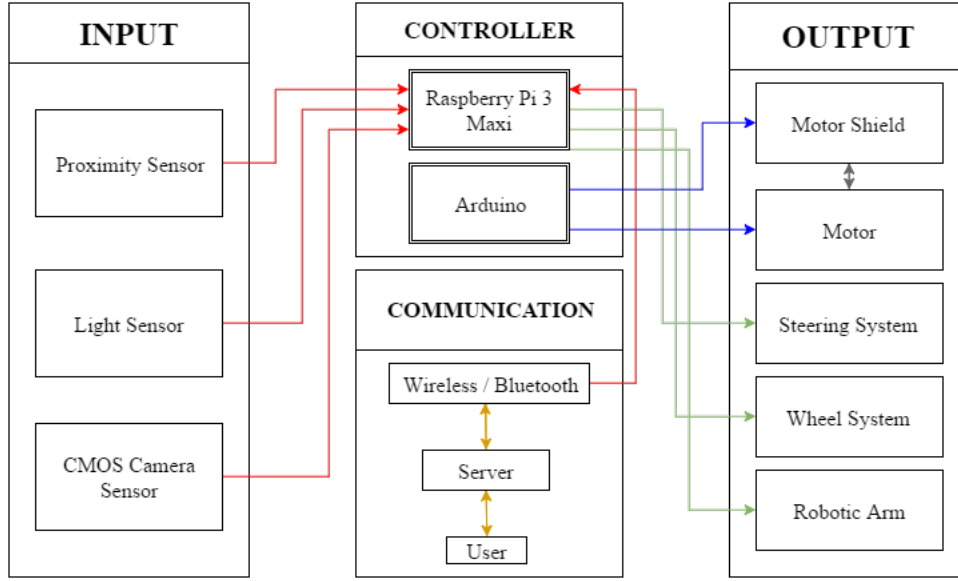


Figure 2: Block diagram of the system

The overall system of **Bastion The Sentinel** consists of 4 main blocks. There are 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 be rotated by 360° and it can be collapsed to minimize the area. Also the gripper part will have the ability to turn 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 data's incoming 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 environment. 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 sensor and vision camera. 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

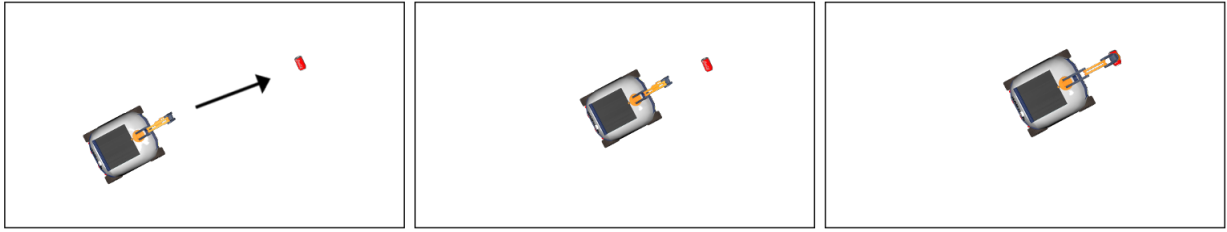


Figure 3: **Bastion The Sentinel** is approaching to an object.

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 empowers 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.

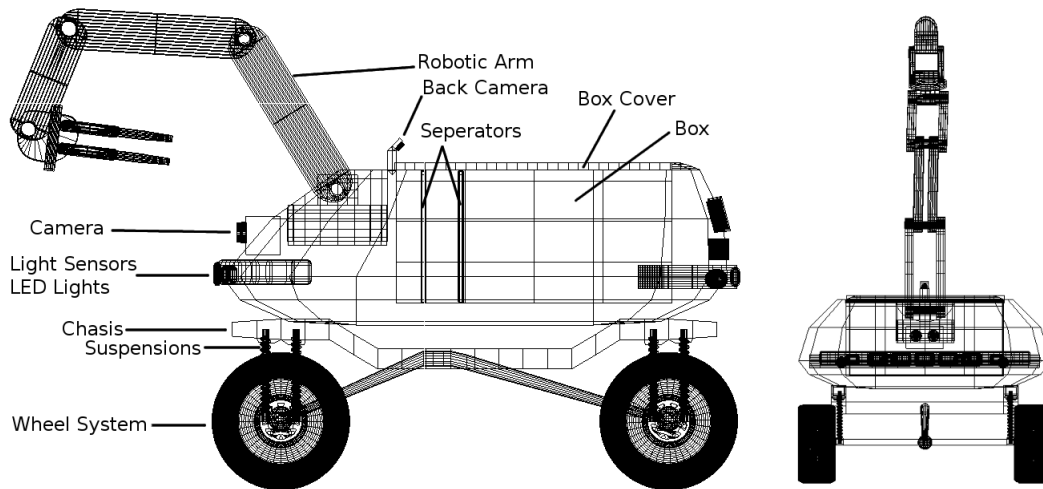


Figure 4: Mechanical design details (Side view and front view)

4.4 Communication Block

The communication will be established with the robot via wireless connection which is on the Raspberry Pi 3. Sensor information will be processed on the robot and will be sent to user. However, video information 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

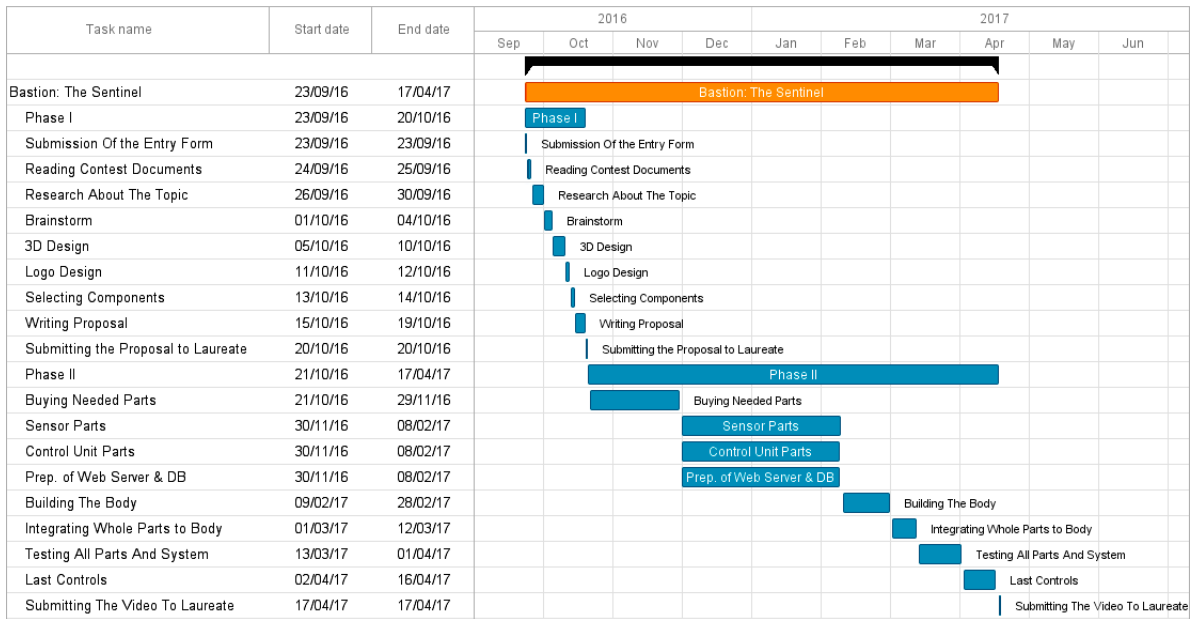


Figure 5: Time table and work schedule

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 while it's operating will be safest way to avoid this type of situations.

9 Business Plan

Comparing the other European countries, Turkey is more polluted. There are many researches for solving this problem. Yet there is not a proper way to accomplish 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. Metal can in 300 years, plastic in 1000 years, glass bottle 1 million years to take dissolve in nature. Also %75 of garbages are occurred by recyclable matters even it's %30 are used in recycling process. Since leaving recycle part to the nature will take eternity to clean itself we thought that someone should step up and do something.