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EXECUTIVE SUMMARY

This report presents details of the project for a teleoperated robot trying to score in opponent's goal and defend its own meanwhile. Remotely controlled robots are widely used in many aspects of our life. Main idea behind this project reflects a real-world problem in occasions where the user has no view of the robot. Therefore, a two-way communication with the robot and user's computer should be established. Reliability and efficiency of this communication is vital since intervening a distant robot which can be unreachable at that instant, by the user can be challenging.

This design will be accomplished by building an efficient communication, a robust mechanical design and reliable electronic system. We aim to achieve satisfactory performance in speed and accuracy. Our final product is to detect the ball on the field, shoot the ball towards the opponent's goal, defend its goal and stay in its half field doing so. Several solution methods are sufficiently described in the following sections of this report.

Our company is composed of five shareholders with different specialization fields and backgrounds. Therefore, each team member came up with a solution from a different point of view. We merged these perspectives in order to construct solution approaches at this point of our design process.

There are three main key points that are discussed in detailed in the following part. However, they can be summarized as below:

Detection:

The robot will use the detection subsystem to determine its location on the field, the ball and perhaps the opponent robot, and thus take the optimal position

Brief solution approaches for shooting the ball illustrates but not limited to, the statements below;

- The location of the objects can be determined by 5 different detection methods, which can be constructed with light and sound sensors and those for different purposes.

Communication:

The robot will be controlled remotely, so there will be a communication link between the robot and the controller.

Brief solution approaches for shooting the ball illustrates but not limited to, the statements below;

- We can use pre-constructed modules using different protocols except Wi-Fi or we can construct our own protocol and communication link.

Shooting:

The robot has to shoot the ball accurately in order to score a goal. Therefore, shooting mechanism should be reliable.

Brief solution approaches for shooting the ball illustrates but not limited to, the statements below;

- We can construct a spring system, keep it pressed and release it to shoot the ball. In addition, we can shoot the ball with an arm attached to a motor.

Even though our base knowledge is similar, each team member chose to study in different fields. Therefore, at certain levels of the design process and solution offering, each member has a different idea and experience. Ms. Arabacı is more experienced in controller design and system modelling which will help her to guide and inform the team, Ms. Coşkun and Mr. Göksu will lead the team with their mechanic & analog design and integration skills. Mr. Beyenir's skills & background in image processing will help us in programming stage and last but not least Mr. Elik will take an active role in building a durable and stable communication system.

Final product will be delivered in best way with a cost of 200$, at the end of 7 months by PITECH engineers. Once the customer purchases the final product, they will own the final action robot consisting of mechanical subsystems, camera, sensors and drivers. In addition to these, a user manual, a warranty document, required software tools, four batteries, two battery chargers, three game field walls, two balls (one is extra) and a dummy robot are also provided.

INTRODUCTION

In the last few decades, robots are gaining more complex abilities, thanks to improvements of technology, that they substitute for humans in many fields of industry. This progress enables us to handle things easier and, in more time, efficient way since their performance is better than ours in many aspects of our daily life such as personal, professional life etc.

Being a newly founded company with five highly motivated, young engineers from different specialization fields such as electronics, control, computer and telecommunications; our aim is to develop a teleoperated robot that can play hockey which includes trying to score in opponent's goal and also defend its own goal. Apart from the specifications defined above we intend to come up with the best featured robot possible.

In this project, our main purpose is to build a robot that we can control from a specified distance with a remote controller. In order to fulfill this requirement, we need to find an efficient way to transfer data from our robot to the main computer. This is a two-way communication since we will send directions to the robot so that it can move with respect to these commands. Moreover, our robot's image processing features should also be highly reliable since we want to detect the ball, tell the difference between our goal and the opponent's, should stay in our half field so that we can improve our chance to score a goal and win the round. In addition to image processing, the mechanical structure of the robot should also be robust so that it can endure possible encounters with the ball. To sum up, this project and its solutions may contribute to the areas where teleoperated robots are used for many different purposes.

In this report, a detailed analysis of this project is presented. Standards are defined, solution approaches for each subsystem is discussed, team organization, tentative cost-budget analysis and time plan of the project is introduced.

TEAM ORGANIZATION

All the executives of PI Tech are electrical and electronics engineers and specialized in different areas of electrical and electronics engineering. This diversity makes our company able to approach problems with different point of views.

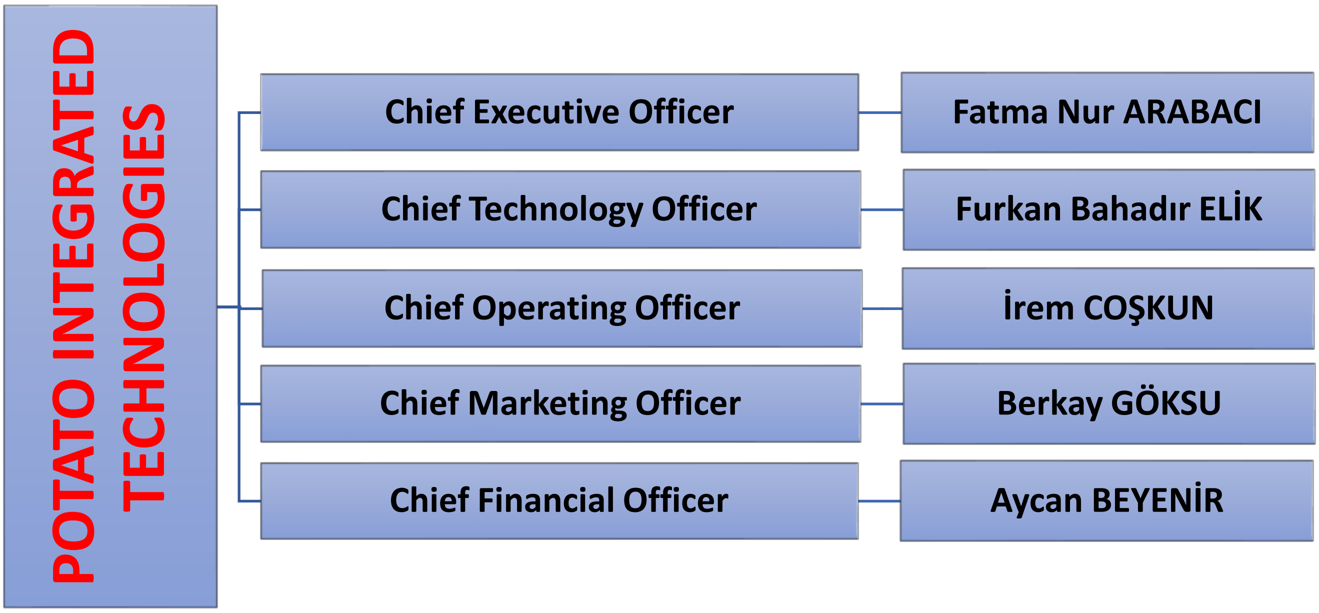


Figure 1 Organizational Structure of Potato Integrated Technologies

Fatma Nur ARABACI

Ms. Arabacı is specialized in control systems area in her undergraduate education in METU. With her experience in control systems and mechanical design, she can contribute to the design of the overall system of the robot and development of its control system.

Outstanding communication skill and organized approach on problems make Ms. Arabacı a top candidate for CEO position.

Furkan Bahadır ELİK

CTO

Microwave / RF Area

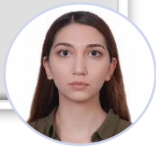
Mr. Elik is specialized in Microwaves and Antenna and Telecommunications area in his undergraduate education in METU. With his experience in wireless communication systems and protocols, he can contribute to the construction of communication subsystem and its integration to the system.

Insight on new technologies and practical approach to problems make Mr. Elik perfect candidate for CTO position.

İrem COŞKUN

COO

Computer Area



Ms. Coşkun is specialized in Computer area in her undergraduate education in METU. With her experience in various computer languages, she can contribute to the development of the coding algorithm of the project.

Natural born leadership skills and her attention to detail make Ms. Coşkun the best candidate for COO position.

Berkay GÖKSU

CMO

Computer Area

Mr. Göksu is specialized in Computer area in his undergraduate education in METU. With his experience in coding algorithms optimization, he can contribute to the improvement and optimization of the coding algorithm of the project.

Broad network in the market and critical connections of him make Mr. Göksu the most suitable candidate for the CMO position.

Aycan BEYENİR

CFO

Electronics Area

Mr. Beyenir is specialized in Electronics area in his undergraduate education in METU. With his experience in robotics and motor drivers, he can contribute to the design of overall system and optimization of motor drive subsystem.

Outstanding financial foresight and previous experiences on accounting make Mr. Beyenir perfect candidate for CFO position.

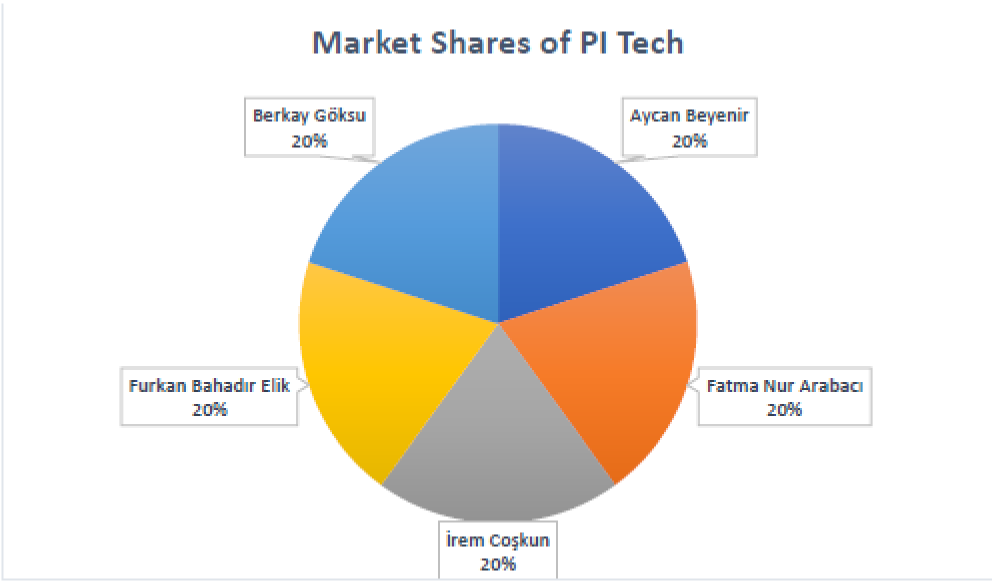


Figure 2 Shareholders of Potato Integrated Technologies

STATEMENT OF THE PROBLEM AND REQUIREMENT ANALYSIS

The project we choose is "Device trying to score in each other's goal". The goal of this project is to design and construct a teleoperated robot (controlled from a distance up to at least 30 meters) which can compete with a similar robot in shooting and scoring to opponent's goal. Functional, physical and performance requirements of the project are as follows:

Functional requirements:

- Detect the start signal
- Monitor the surrounding
- Process the monitored data
- Encode the processed data for communication
- Transfer the encoded data to the teleoperator

If the ball is at players half-field and far away from the robot:

- Transfer the movement direction command given by the teleoperator, to move toward the ball
- Perform the move operation respect to the command transferred from teleoperator
- Move robot to the ball until ball is in the shooting range
- Transfer the hit the ball command given by the teleoperator
- Perform the hit the ball operation given by teleoperator

If the ball is at opponent's half-field:

- Transfer the movement direction command given by the teleoperator, to cover the goal, given by the teleoperator
- Perform the move operation respect to the command transferred from teleoperator
- Move robot to the own goal to protect it from the incoming shoot
- Protect the goal respect to the commands from teleoperator

Physical requirements:

- Goals must be at least twice as wide as their defenders' lateral dimensions.
- Robots can hit, push or otherwise drive the ball but not grasp, scoop or otherwise carry it. So, robot cannot have a grasping or scooping part.
- The playfield also has some physical requirements:
  - The playfield should be regular hexagon on a bare floor, with center-line and goal lines marked by "masking tape".
  - The playfield constructed from 6 sidewalls of 70-75 cm length each and two goals snugly fit at the opposite corners, while preserving symmetry.

Performance requirements:

- Ball should be transferred to opponent's half-field in no more than 20 seconds from the project description. For our team for successful operation it should be less than 15 in order not to have any unforeseen violations. So, consistency of operation in this case is important. It should transfer the ball to the opponent field less than 15 seconds at least 55% of the time and other times it should be less than 20 seconds because of project description.
- The operator remotely controls the robot from a distance up to at least 30 meters.
- The transmission between the robot and receiver should be less than 1 second for successful operation. So, less than 4 points for transmission delay objective is unacceptable.
- In order to have successful operation aiming precision of the robot should not be less than 45%. So, less than 4 points for precision objective is unacceptable for our company.
- The robot's throwing mechanism should be strong enough to throw the ball to opposing goal.
- The robot's structure should not be affected by hitting the ball fast to the robot, so, durability of the robot cannot take less than 4 points.

Constraints:

- The robot is not allowed to cross the center-line
- The ball must be transferred to the opponents half field no more than 20 seconds
- The communication between robot and teleoperator must happen from a distance at least 30 meters
- Carrying, grasping and scooping the ball is not allowed. Robot can only hit or push the ball.

Objectives, metrics and related objective trees are given in the next section of this report.

Metrics

Budget: Money which is considered to be spent in order to develop and produce the final project.

In metrics, 10 points will be given for budget considered to be less than 200$, 8 points will be given for budget considered to be between 200-250, and 6 points for the budget between 250-300, 4 points for 300-350, 2 points for 350-400 and no points for budget 400$+.

Fun: Measure of how much each shareholder enjoyed from performing tasks required to complete the project.

In metrics, 2 points will be given for each shareholder who would enjoy.

Performance: Parameters which are considered as important. These can be investigated in three sub-categories:

> **Durability:** Robots ability to preserve its structure and function against external impacts and wear down.
>
> In metrics, 10 points for preserving its structure against the effects caused by collision to wall with a speed of 1m/s and no points for not preserving its structure against the effects of collision to the wall with a speed under 0.1m/s. The points between is distributed linearly with respect to speed.

Consistency: Robot’s ability to execute the same performance under different conditions (starting position, ambient lighting, ambient temperature) using the same line of commands.

In metrics, 10 points for similarity of behavior over 95%, 8 points for similarity of behavior between 85%-95%, 6 points for similarity of behavior between 755%-85%, 4 points for similarity of behavior between 65%-75%, 2 points for similarity of behavior between 55%-65% and no points for similarity of behavior under 55%.

Power Consumption: How long the robot would last on same battery capacity of 1750mAh.

In metrics, 10 points for operation over 2 hours, no points for operation under 20 minutes. The points between will be distributed linearly.

Transmission Delay: Measure of how many second delay of the transmission will the solution have.

In metrics, 10 points for operation less than 100ms delay, 8 points for 400ms delay, 6 points for 700ms delay, 4 points for 1s delay, and more than that will be failure.

Creativity: Measure of how many different solution approaches can be proposed.

In metrics, 2 points will be given for each proposed solution and 1 point will be given for each proposed sub-solution.

Precision: Measure of how accurate robot will aim the opponent’s goal.

In metrics, 10 points for more than 90% precision, 8 points for precision rate between 90%-75%, 6 points for precision rate between 75%-60%, 4 points for precision rate between 60%-45%, the other points will be given accordingly. Less than 4 points is a failure because of our performance requirement.

Table 1: Pairwise comparison chart for top objectives

	Budget	Performance	Fun	Creativity	Precision	Total	Weighted
Budget	-	0	0	1/2	0	0,5	0,05
Performance	1	-	1/2	1	1	3,5	0,35
Fun	1	1/2	-	1	1/2	3,0	0,30
Creativity	1/2	0	0	-	0	0,5	0,05
Precision	1	0	1/2	1	-	2,5	0,25

Table 2: Pairwise comparison chart for performance objective

	Durability	Consistency	Power Consumption	Transmission Delay	Total	Add 1	Weigthed
Durability	-	1/2	1	0	1,5	2,5	0,25
Consistency	1/2	-	1	1/2	2,0	3,0	0,30
Power Consumption	0	0	-	0	0	1	0,10
Transmission Delay	1	1/2	1	-	2,5	3,5	0,35

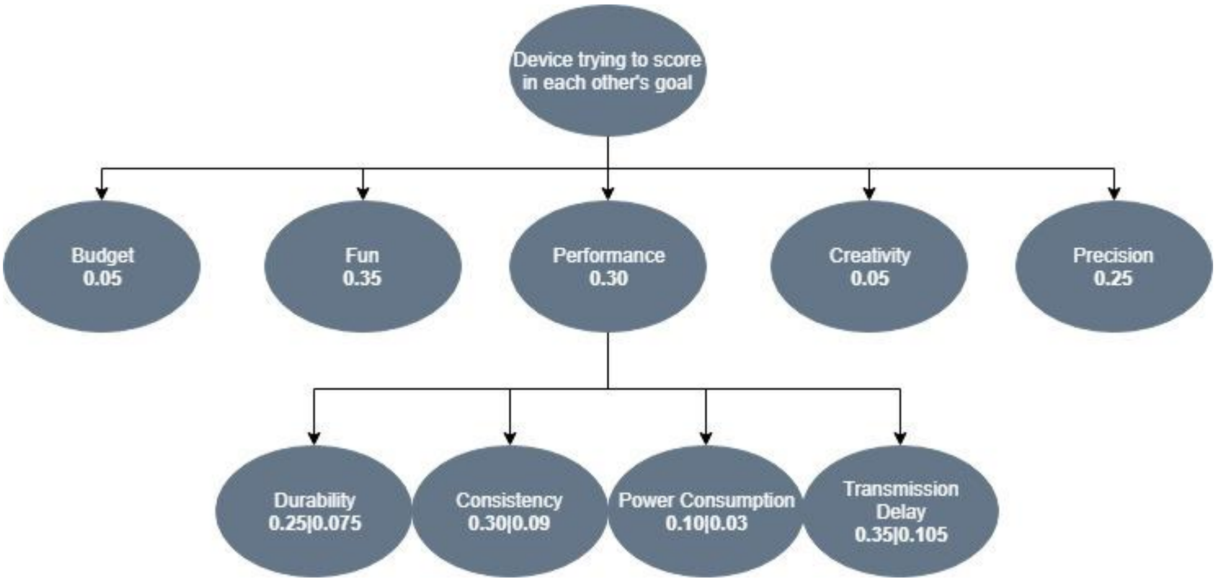


Figure 3: Weighted objective tree for device trying to score in each other's goal

STANDARDS

The ball:

The ball is the object which will be thrown to the opponent's goal in order to score. The ball should be sphere shaped, and it will have a diameter between 30mm-45mm. The exact diameter will be decided later in standards committee. Also, the color of the ball, the material of the ball and the maximum or the minimum weight of the ball will be discussed and later decided in standard committee. The provided balls will satisfy all of these 'to be decided' standards.

The Playfield:

The playfield will be a 2D hexagon with sides having length of 70cm-75cm, and the half-field will be drawn as shown in Figure 4.

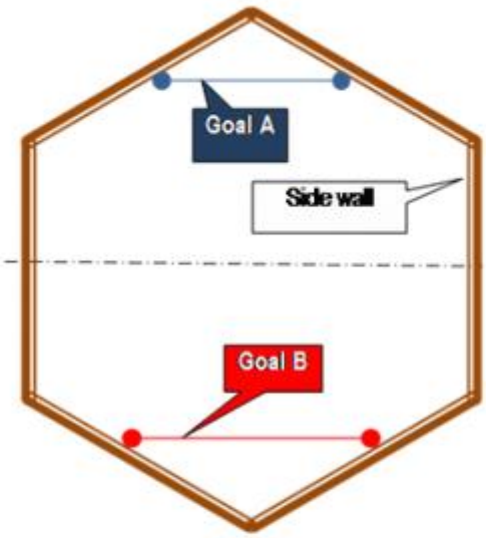


Figure 4 The playfield [ii]

The width of each goal will be determined based on each robot holding it and it will be at least 2 time larger than the width of the robot. The exact ratio, color and the height will be determined in standards committee later. The goals will snugly fit at the opposite corners, while preserving the symmetry. The half-field will be separated by masking tape. On the playfield, there will be no other equipment other than robots and the ball.

The colors of masking tape will be discussed in standards committee. We think that due to different floor types and colors, we will need at least 2 different masking tape colors in order to avoid struggles of detection. Also, the color of the wall will be discussed. We will again suggest the matt colors to avoid bright spots hence the malfunction of the detectors.

The game:

The robots will try to score on opposite goal. However, the rules of the game are not indicated in detail. The exact rules of the game will be discussed and decided. We will suggest that any ball thrown to out of the field should result in 'out' and the ball should be given to opposing robot to continue to the game. On the other hand, the method of measuring 20 seconds limit (to throw the ball out of the half-field) should be decided clearly. We will discuss any topic related to these issues in the standard committee.

SOLUTION APPROACH

- **Power Supply Subsystem:** This subsystem is for distribute power towards other subsystems at required voltage level and with specified current limitations.
- **Communication Subsystem:** This subsystem provides communication between the robot and telecontroller subsystem.
- **Motion Subsystem:** This subsystem consists of wheels and motors driving these wheels by which we provide capability of motion to our robot in the game field.
- **Detection Subsystem:** This subsystem detects the boundaries of the field, the position of the opponent robot & the ball. This subsystem also locates itself in the field.
- **Telecontroller Subsystem:** This subsystem is the one we use to send commands to robot via communication subsystem.
- **Main Processor Subsystem:** This subsystem is the main robot computer onboard which controls other subsystem with respect to feedbacks sent from these subsystems.
- **Shooting Subsystem:** This subsystem is responsible for sending the ball to the opponent's goal with high precision to score a goal.

Submodule Solutions

Power supply subsystem

The power supply subsystem is the main source of electricity in the robot. The main challenge in this subsystem is the different voltage and current need of the other subsystems. To give an example the motion subsystem needs high voltage and high current, on the other hand the subsystems consisting sensitive components need low voltage low noise power source and protection from the voltage overshoots caused by motor. We suggest two different approaches for this subsystem

First approach is using a Li-Po battery as a power source and regulating it for special uses by using a regulator circuit. This regulator both create different voltage and current for the needs of subsystems and isolate all subsystems from each other.

Second approach is using both two batteries in the system to isolate motion subsystem from the rest of the subsystems. In this approach motion subsystem is supplied by Li-Po battery (high voltage, high current) and sensitive subsystems are supplied by Li-ion battery (low voltage, low noise). By using two different batteries we can isolate motor and sensitive components for extra protection.

Communication System:

The robot will be controlled remotely by a user, that is, the robot will not be automated, and this control will be achieved by wireless communication. However, this communication is restricted to non-Wi-Fi systems. Use of Wi-Fi protocol is prohibited by any means, however other communication protocols are allowed such as Bluetooth. Other than known protocols, team can design their own protocols to communicate between the tele-operator and the robot. The main concern on design of this submodule is range issue. The robot should be able to be operated remotely at least 30 m away. Also, effects of the obstacle like walls or people etc. should be neutralized. We suggest three different approaches for this subsystem

First approach utilizes a Bluetooth module to transmit data between operator and the robot. In this approach, the direct image or the reduced image (processed and reduced in size) will be sent to the remote controller. And the commands from the operator will be sent in data packets specified later.

Second approach utilizes xBee RF modules. These modules work in similar way that Bluetooth modules work. The difference in xBee modules is that they offer different frequency bands to communicate. So, the link will be less likely to be subject to interference.

The last approach involves designing a unique system with our own frequency bands and protocol. This way we will be free to choose any frequency, hence, we will not need to care about interference with different robots. Using this approach, the complex coding will be avoided, and the resultant cost will be dramatically less than other approaches.

Motion Subsystem

Motion subsystem consists of a motor and wheels. In order to have higher speed a motor with high torque rate and low rpm needed. For wheels our team came up with different ideas. We decided it is important to for out robot to face the opponents goal all the time. Omni wheels are a solution approach for this. Also, it is possible to have regular wheels mounted perpendicular, so, our robot may not only move forward and backward also can move to its right and left. Wheels may be connected to same motor or different motors. PID controller is required for position control of the DC motors. Another thing is if the solution approach consists regular wheels and two motors, a controller is required to be sure that they have the same speed, so, our robot always face forward.

A robot only goes forward and backward can be helpful for different solution approaches for different subsystems.

Detection Subsystem:

Detection Subsystem is the part of the project that the project developers can offer creative solutions. Therefore, we found 5 different solutions.

First approach is using LIDAR for detection of objects. LIDAR (Light Detection and Ranging; or Laser Imaging Detection and Ranging) is a technology used to understand the distance of an object or surface using laser pulses. It is similar to radar technology. The radio waves used in the radar are replaced with light, i.e. laser pulses. Hence, we can use this approach for detecting the ball and the position of robots.

Second approach is using ultrasound sensor for detection of objects. An ultrasonic pulse is generated in a particular direction. If there is an object in the path of this pulse, part or all of the pulse will be reflected back to the transmitter as an echo and can be detected through the receiver path. By measuring the difference in time between the pulse being transmitted and the echo being received, it is possible to determine the distance. Therefore, this approach is our second alternative.

Third approach is using IR proximity sensor for detection of objects. The principle of operation of an infrared sensor is based on infrared light that is reflected when hitting an obstacle. An IR receiver captures the reflected light and the voltage are measured based on the amount of light received. Infrared sensors are used in a wide range of applications including here proximity robotic applications for distance and object detection, or color detection and tracking. As a disadvantage, IR sensors have bad performance in strong sunlight and many applications where this type of sensor is used are designed for indoor use. Hence, there will be some problems when we try to use in daylight. As an advantage, the low prices of these sensors are budget friendly.

Fourth approach is using a camera for detection of objects. This approach is based on the principle of taking the image using a single camera and processing it. We can wait for the image to be taken instantaneously and processed in the control unit.

Fifth approach is using Stereo camera for detection of objects. This approach is based on the principle of measuring the distance of the ball and the other robot with the double camera. As can be seen in figure below, by adding a second camera in-plane with the first, stereo vision, the means by which humans perceive depth, can be achieved. With stereo vision, distance to common features in the two images is extrapolated by comparing the relative positions of those features on their respective images, and factoring in known parameters about the camera system such as focal length of the cameras.

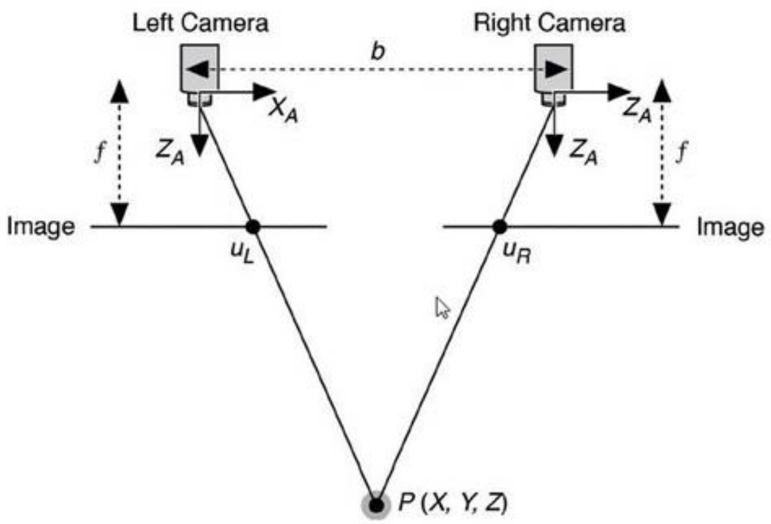


Figure 5: Stereo vision uses trigonometry to figure out how far away from a robot things are

Telecontroller subsystem

Telecontroller subsystem is the unit where the data coming from the detection subsystem are displayed and all the commands from the operator are send to the robot via communication subsystem. Because of that this subsystem needs to have a control interface and a display. We suggest three different approaches for this subsystem.

First approach is using computer as a telecontroller with graphical user interface. In this approach we can use the computer screen as a display and keyboard as a controller. This approach provide low cost solution since it needs no external device. On the other hand, the limitations of keyboard make controlling the robot harder.

Second approach is developing a standalone controller for this subsystem which have onboard display. This approach provides the user great control over the robot. On the other hand, development of this unit will consume too much time and create additional cost.

Third approach is developing a hybrid solution for this subsystem. In this approach we combine the computer and a controller such as joystick to benefit from the strength of both. To lower the cost, we use no external display unit, instead we use the computer screen as a display. To increase the control over the robot, we connect a controller to the computer. This approach creates a mid-point between the previous two approaches.

Main Processor Subsystem

This subsystem is the brain of the robot onboard since it communicates with other subsystems, receives data from them and send commands. We thought of four different possible main processors for this purpose which are FPGA, Raspberry Pi, Arduino or TI Tiva Board. Main advantage of using FPGA is that it is fast, but it is also expensive and more complex compared to other options. Raspberry Pi is not as expensive as FPGA but not cheap as well. It's modular so different variety of sources are easily accessible. Although, Arduino is the cheapest option but since it is a microcontroller, we need another module to fully operate the complete system. On the other hand, since it is commonly used different libraries can be found. The last option can be using TI Tiva Board which is considered to be inexpensive. However, this is not as modular as the rest, therefore it may be challenging to find required documentation about programming.

Shooting Subsystem

We presented two main solutions for this subsystem at this stage of our design process. One of them is constructing an external module for shooting the ball which can be in the form of a hockey stick attached to a motor or a spring system. Other than the stick form it may a have a wider V shape with the same motor or spring attachment. Another way is shooting the ball with robot's body. In this approach the robot will align itself with respect to the ball position and where the ball is desired to be sent and then hit the ball after acquiring necessary speed.

Subsystem Tests

Power supply subsystem

- **Supply test:** Subsystem should be able to generate necessary supply voltages and currents to the other subsystems. We can apply this test by connecting the subsystem to a programmable electronic load.
- **Isolation test:** Subsystem should be able to isolate other subsystems in power source manner. By creating a protection this subsystem must eliminate voltage overshoots. We can apply this test by connecting the subsystem to a programmable electronic load and giving external voltage overshoots.
- **Short circuit protection test:** This is the most important test of power supply subsystem. When a short circuit occurs, the system should protect itself by automatically cutting the supply.

Communication subsystem

Testing procedure for each approach will start with blinking a led at a certain distance. After that, the ranging issues will be tested while performing the test from different distances. Finally, the meaningful data, the data contains packets for controlling the robot and taking information from the robot, will be sent via each approach. Then the best of all will be used for final product.

Motion Subsystem

- **Speed Test:** Our robot should be able to move to a stationary ball at the half line from the further point in its goal in 3 seconds when it is having full speed.
- **Speed Test for Pivot Movement**: Robot should be able to pivot around its center axis less than a second.
- **Power Rating Test:** Under full load conditions, maximum power drawn from the system will be tested.

Detection Subsystem:

- **Alignment of the playfield test**: alignment mismatch of the playfield center line should be zero after testing for 20 times.
- **Accuracy of the detection test:** Mismatch of the ball detection accuracy should be at most %5 after testing 20 times.

Telecontroller subsystem

- Display precision: Subsystem should be able to precisely display the incoming location data from the communication subsystem. We can apply this test by giving computed generated input signals to this subsystem and comparing the result on the display with our expected results.
- Control precision: Subsystem should be able to generate precise control signals respect to the controllers' commands. We can apply this test by giving predefined commands to the subsystem and comparing the signal output to our expected results.
- Response time: Subsystem should be able to display the incoming display data and transfer the ongoing control data as fast as possible. To determine the response time there is no need to make any additional tests, but only recording the response time of the previous test will be sufficient.

Main Processor Subsystem

The efficiency and the complexity of our code in different processors are examined to see which one is more rational to use. We will decide on which option is faster and more accurate than the others.

Shooting Subsystem

How far the ball is sent will be measured and also the accuracy will be tested by inspection. The efficiency of the motor and the spring module will be analyzed to compare the effectiveness of each.

DELIVERABLES

As Potato Integrated Technologies, providing creative and reliable solutions to our customers is a matter of paramount importance for us. To accomplish the highest customer satisfaction, we provide high quality robotic solutions specified for the problem. Therefore, the final product that is going to be served to the customer is guaranteed to satisfy our policy of quality.

After the final product satisfies all field test, our customers will receive a complete delivery of the main unit, auxiliary equipment, documentations and software. The robot unit, auxiliary equipment, documents and software that are going to be in the delivery packet are summarized below

Main Unit: This package contains the main delivery; the robot unit which will take a part in a competition where it tries to score to the opponents' goal and protect its goal and a controller unit which the operator going to use for teleoperate the robot unit.

Auxiliary Equipment: This package contains equipment necessary to fully operate the robot and build the competition environment. The pack contains; computer to robot communication module, 2 Li-Po batteries (one main, one spare), 2 Li-Ion batteries (one main, one spare), two battery chargers (one for Li-Po and one for Li-Ion), 3 Walls for game field, self-goal (at least twice the size of robot unit), two ball (diameter 30-45 mm) (one is spare), a dummy robot (for demonstration and sparring purposes).

Documents: This package contains the all the necessary documents in hardcopy. This pack contains; one instruction manual, complete list of part used in the main unit and their reference codes, a 2-year warranty and a 5-year spare part support.

Software: This package contains a digital source of necessary documents and computer interface. The computer interface has two purposes; first one is making necessary adjustments on the robot for different environmental condition and second one is for teleoperating the robot using the computer as a teleoperator. The digital documents consist of; 3-D models of 3-D printed parts on SOLIDWORK and digital versions of user manual and complete list of part used in the main unit, their reference codes and their datasheets.

COST & BUDGET ANALYSIS

Budget of the project should be less than or equal to 200$. Our solution approach will take almost the maximum allowed budget which is 200$. Since we have not decided which approaches we will take and which materials we need specifically, budget analysis is going to be approximate. Also, in order to reduce our costs, we decided to buy used items. 20% of the system will be used to purchase motors and drivers, 10% of the budget will be used to construct the body. 5% of the money will be used to construct our goal and half field. 50% of the budget will be used on microprocessors, sensors, cameras, microcontrollers. 5% of the money will be used of batteries or other power supply methods. Wheels will be purchased with 5% of the budget. Remaining 5% of the budget will be used on tools.

CONCLUSION

As Potato Integrated Technologies, we have made one of our most important decisions. We decided which project we would be working on for the next 6 months. When we decided to do so, we did many tests, made evaluations with the help of graphs and numerical metrics, so we tried to decide which project was more appropriate for us. This process was not very easy for us, but we chose the project that we thought was most suitable for us and now we have all focused on it. The project we selected is the teleoperated robot project, which is announced as “devices trying to score in each other’s goals.

We have made the metrics more suitable that we use to compare the projects to examine the selected project in detail. We have learned that the techniques that should be used when selecting a project can be used in solution approaches. Firstly, we divided the project into submodules. We have tried to offer separate solutions for each module and discussed it. At this stage, even if we do not choose any solution as a priority, we have an idea about the problems we may encounter and how we can approach them. While exposing these ideas, brainstorming was used as a highly effective method and many solution suggestions were brought.

When the project was decided, it was very important to correctly define the problems. That's why standards are mentioned a lot. The solution approaches to be efficient and consistent, the field, ball and other rules should be fully understood. We have also reviewed and discussed these standards and rules for each submodule. Finally, we have made necessary work on the time and budget of the overall project.

Potato Integrated Technology has once again demonstrated that it is a team that can handle any workload for the successful completion of this project. This company, which was founded by 5 people from different fields, started to do the necessary work to make this robot to be very creative and the best.