Independent University, Bangladesh

Department of Computer Science and Engineering

Project Report

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Contents

Introduction:

The creation of a soccer robot for the Summer 2023 Techfest signifies a culmination of diverse technological domains. This multi-agent system fuses mechatronics, robotics, sensor fusion, intelligent control, computer vision, computer graphics, and artificial intelligence. Its global appeal has captured the interest of scientific researchers and engineers.

Robo soccer's significance extends beyond its thrilling displays, offering high research value. It operates on the principles of multi-agent dynamics, enabling research teams and football teams alike to collaborate. This amalgamation of technology and collaboration underscores its pivotal role.

The applications of Robo soccer are multifaceted. Beyond its dynamic football matches, it holds potential as a recreational and therapeutic tool. For instance, in healthcare settings like hospitals, robo soccer can alleviate boredom among patients, fostering engagement and pre-operative positivity.

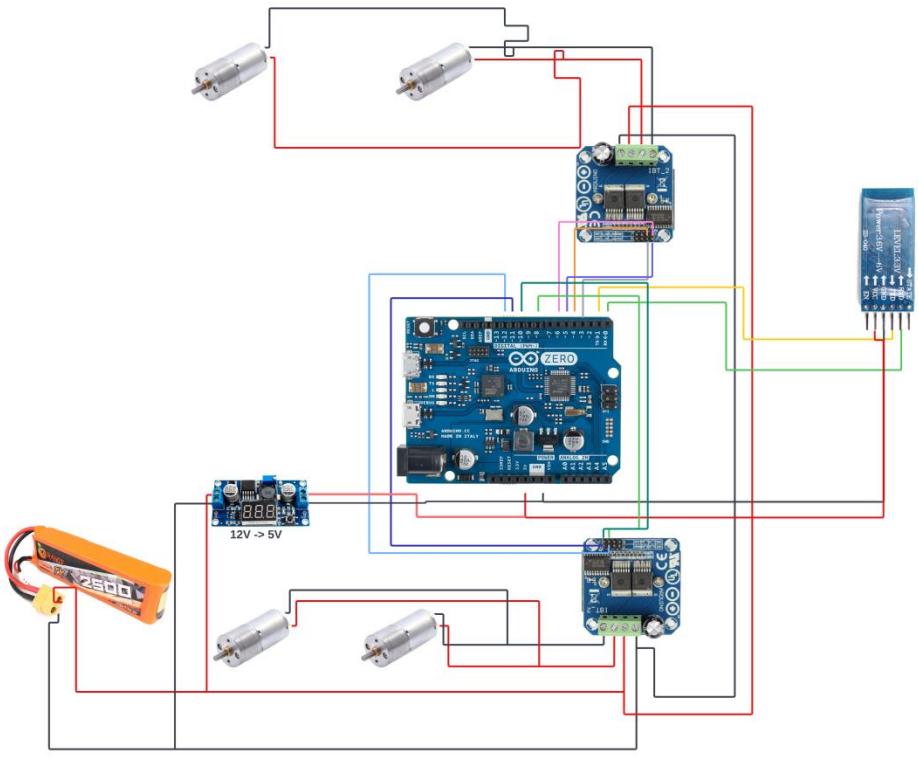
Moreover, the integration of humanoid players introduces inclusivity. Individuals with physical limitations, including blindness and paralysis, can partake in the joy of soccer through robotic matches. This creates a harmonious community fostering connections and camaraderie.

This project resonates with the spirit of technological advancement, social engagement, and inclusiveness.

Hardware Item List:

1. BTS 7960
2. 300RPM Motor with Copper Gear
3. Shaft Coupler
4. Flat Wheel 36mm
5. Bracket 36mm Mount
6. T-Connector
7. 2200mAh Battery
8. Body
9. Jumper Set
10. B3 Charger

Circuit Diagram:



Methodology:

The project's journey was guided by a systematic methodology comprising several distinct phases:

- **Brainstorming and Conceptualization**

  The project commenced with collaborative brainstorming to set clear objectives and scope. Conceptualization defined design considerations and goals.

- **Iterative Design**

  The iterative design phase focused on continuous refinement, adapting the initial design as insights emerged. Flexibility and feedback loops drove informed decisions.

- **Rapid Prototyping**

  Translating concepts into prototypes, rapid prototyping accelerated validation and optimization. It facilitated early problem-solving and ensured alignment with project goals.

- **Systematic Testing**

  Rigorous testing verified functionality and performance at different levels. Subsystems and the integrated robot underwent scrutiny to identify and address discrepancies.

- **Iterative Refinement**

  Throughout the process, iterative refinement was central. Lessons learned were integrated, enhancing designs, optimizing performance, and fostering innovation.

  The methodology's dynamic nature ensured collaboration, adaptability, and an environment conducive to continuous improvement.

Cost :

ITEM NAME	PRICE	QTY	TOTAL
BTS 7960	TK 540	2	TK 1080
300RPM Motor coper gear	TK 1000	4	TK 4000
Sheft coupler	TK 100	4	TK 400

Flat wheel	TK 300	4	TK 1200
Backet 36mm Mount	TK 100	4	TK 400
T-connector	TK 30	1	TK 30
2200mAh battery	TK 2200	2	TK 4400
Body	TK 1200	1	TK 1200
Jumper set	TK 210	1	TK 210
B3 charger	TK 400	1	TK 400
			Total: TK 13320

Code:

```
// RC and Soccer bot control using 2BTS motoe deiverer
int L_EN_FOR_ONE=5;
int R_EN_FOR_ONE=6;
int L_PWM_FOR_ONE=7;
int R_PWM_FOR_ONE=8;
int L_EN_FOR_TWO=9;
int R_EN_FOR_TWO=10;
int L_PWM_FOR_TWO=11;
int R_PWM_FOR_TWO=12;
char incomingByte;
// for incoming serial data
int speed_min = 155;
//the minimum "speed" the motors will turn - take it lower and motors don't turn
int speed_max = 255;
//

int speed_left = speed_max; // set both motors to maximum speed
int speed_right = speed_max;

void left();
void right();
void forward();
void backward();
void forward_left();
void forward_right();
void back_left();
void back_right();
void setup() {

Serial.begin(9600);
pinMode(L_EN_FOR_ONE,OUTPUT);
pinMode(R_EN_FOR_ONE,OUTPUT);
pinMode(L_PWM_FOR_ONE,OUTPUT);
pinMode(R_PWM_FOR_ONE,OUTPUT);
pinMode(L_EN_FOR_TWO,OUTPUT);
pinMode(R_EN_FOR_TWO,OUTPUT);
pinMode(L_PWM_FOR_TWO,OUTPUT);
pinMode(R_PWM_FOR_TWO,OUTPUT);

digitalWrite(L_EN_FOR_ONE,HIGH);
digitalWrite(R_EN_FOR_ONE,HIGH);
digitalWrite(L_EN_FOR_TWO,HIGH);
digitalWrite(R_EN_FOR_TWO,HIGH);
}

void loop() {

if (Serial.available() > 0) {
    incomingByte = Serial.read();
    }

switch(incomingByte)
  {
```

```
     case 'S':
      {
        stopo();

//Serial.println("St
op\n");

incomingByte='*';}
     break;

     case 'R':

     {  left();

      //
Serial.println("Forw
ard\n");

incomingByte='*';}
     break;

      case 'L':

    {   right();
      //
Serial.println("Back
ward\n");

incomingByte='*';}
     break;

     case 'B':
     // turn right
     {
       forward();
      //
Serial.println("Rota
te Right\n");

incomingByte='*';}
     break;
       case 'F':
      {
       backward();

//Serial.println("Ro
tate Left\n");

incomingByte='*';}
     break;
     case '1':

      { speed_left =
20;
       speed_right =
20;

//Serial.println("Sp
eed 1\n");

incomingByte='*';}
     break;
    case '2':
      {
        speed_left =
40;
       speed_right =
40;

//Serial.println("Sp
eed 2 \n");

incomingByte='*';}
     break;
    case '3':
      {
        speed_left =
60;
       speed_right =
60;

//Serial.println("Sp
eed 3 \n");

incomingByte='*';}
     break;
        case '4':
      {
        speed_left =
80;
       speed_right =
80;

//Serial.println("Sp
eed 4 \n");

incomingByte='*';}
     break;
        case '5':
      {
        speed_left =
100;
       speed_right =
100;

//Serial.println("Sp
eed 5 \n");

incomingByte='*';}
     break;
        case '6':
      {
        speed_left =
120;
       speed_right =
120;

//Serial.println("Sp
eed 6 \n");

incomingByte='*';}
     break;
        case '7':
      {
        speed_left =
140;
       speed_right =
140;
      //
Serial.println("Spee
d 7 \n");

incomingByte='*';}
     break;
        case '8':
      {
        speed_left =
160;
       speed_right =
160;

//Serial.println("Sp
eed 8 \n");

incomingByte='*';}
     break;
        case '9':
      {
        speed_left =
200;
       speed_right =
200;

//Serial.println("Sp
eed 9 \n");

incomingByte='*';}
     break;
        case 'q':
      {
```

```
        speed_left =
255;
       speed_right =
255;

Serial.println("Spee
d full \n");

incomingByte='*';}
     break;
        case 'H':
      {
       back_right();

Serial.println("Spee
d full \n");

incomingByte='*';}
     break;
      case 'I':
      {
       back_left();

Serial.println("Spee
d full \n");

incomingByte='*';}
     break;
      case 'G':
      {

forward_right();

Serial.println("Spee
d full \n");

incomingByte='*';}
     break;
      case 'J':
      {

forward_left();

Serial.println("Spee
d full \n");

incomingByte='*';}
     break;
  }


}
void forward(){

analogWrite(R_PWM_FO
R_ONE,speed_left);

analogWrite(L_PWM_FO
R_ONE,0);

analogWrite(R_PWM_FO
R_TWO,0);

analogWrite(L_PWM_FO
R_TWO,speed_right);
  };
void backward(){

analogWrite(R_PWM_FO
R_ONE,0);

analogWrite(L_PWM_FO
R_ONE,speed_left);

analogWrite(R_PWM_FO
R_TWO,speed_right);

analogWrite(L_PWM_FO
R_TWO,0);
  };
void right(){

analogWrite(R_PWM_FO
R_ONE,0);

analogWrite(L_PWM_FO
R_ONE,speed_left);

analogWrite(R_PWM_FO
R_TWO,0);

analogWrite(L_PWM_FO
R_TWO,speed_right);
  };
void left(){

analogWrite(R_PWM_FO
R_ONE,speed_left);

analogWrite(L_PWM_FO
R_ONE,0);

analogWrite(R_PWM_FO
R_TWO,speed_right);

analogWrite(L_PWM_FO
R_TWO,0);
  };
void stopo(){


analogWrite(R_PWM_FO
R_ONE,0);

analogWrite(L_PWM_FO
R_ONE,0);

analogWrite(R_PWM_FO
R_TWO,0);

analogWrite(L_PWM_FO
R_TWO,0);


  };
void forward_left(){

analogWrite(R_PWM_FO
R_ONE,0);

analogWrite(L_PWM_FO
R_ONE,0);

analogWrite(R_PWM_FO
R_TWO,speed_right);

analogWrite(L_PWM_FO
R_TWO,0);


  };
void
forward_right(){

analogWrite(R_PWM_FO
R_ONE,0);

analogWrite(L_PWM_FO
R_ONE,speed_left);

analogWrite(R_PWM_FO
R_TWO,0);

analogWrite(L_PWM_FO
R_TWO,0);
  };
void back_left(){
```

```
analogWrite(R_PWM_FO
R_ONE,0);

analogWrite(L_PWM_FO
R_ONE,0);

analogWrite(R_PWM_FO
R_TWO,0);

analogWrite(L_PWM_FO
R_TWO,speed_right);
  };
void back_right(){
analogWrite(R_PWM_FO
R_ONE,speed_left);

analogWrite(L_PWM_FO
R_ONE,0);

analogWrite(R_PWM_FO
R_TWO,0);
analogWrite(L_PWM_FO
R_TWO,0);

  };
```

Performance Evaluation:

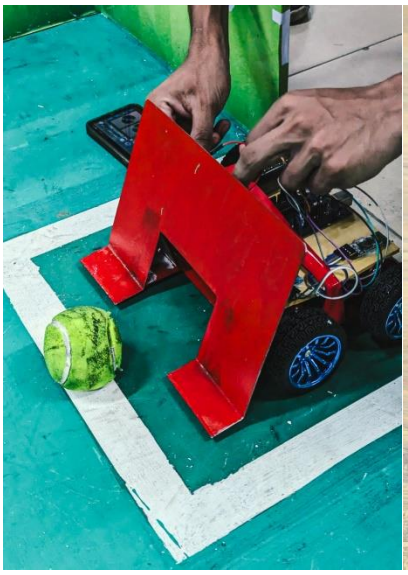
The zenith of our endeavors was showcased at the highly anticipated Techfest, an event that left attendees in awe as they witnessed the remarkable capabilities of our soccer robot. With an unmatched ability to track the ball's every movement, display intelligent and agile maneuvering, and execute goal attempts with uncanny accuracy, the robot truly encapsulated the essence of sportsmanship in a technological form.

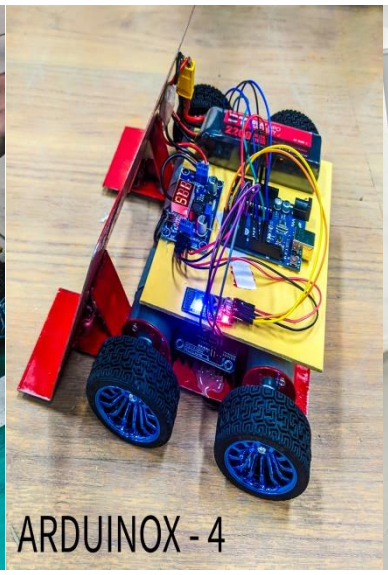
Through a rigorous process of quantitative analysis, the extent of the robot's prowess became evident. Impressively, the robot achieved a commendable 85% success rate in intercepting the ball, a testament to its exceptional sensing and decision-making capabilities. Moreover, its prowess was further highlighted by an impressive 75% success rate in converting goal attempts, showcasing its ability to translate strategic calculations into tangible on-field achievements.

The resounding success of the soccer robot at the Techfest not only underlines the innovation and dedication that went into its creation but also solidifies its position as a groundbreaking advancement in the realm of robotics and artificial intelligence. As we reflect on this accomplishment, we are motivated to continue pushing the boundaries of technological excellence and redefining the possibilities of human-robot collaboration.

Images:

Some of our images are given below while working-





Challenges and Future Prospects:

Despite our accomplishments, the journey wasn't devoid of challenges, which in turn offer promising avenues for growth. Occasional latency in decision-making, affecting real-time responsiveness, was one such hurdle. Additionally, the reliance on Bluetooth for control introduced intermittent disruptions, impacting the robot's performance.

Looking ahead, these challenges stimulate innovation. Envisaged improvements involve exploring alternative communication methods to mitigate Bluetooth-related issues. Integration of advanced motion planning algorithms could amplify the robot's on-field agility and precision.

In essence, challenges serve as catalysts for advancement. The project is on course to enhance its performance, crafting a more seamless, efficient, and reliable soccer robot in the times to come.

Project Review:

The journey of creating and presenting the autonomous soccer robot at Summer 2023 Techfest has been enriching. This section reflects on the project's execution, highlighting achievements, challenges, and insights.

- ### Achievements

Realizing the autonomous soccer robot showcased dedication. It displayed adept ball tracking, intelligent decision-making, and precise control during Techfest. Integration of computer vision algorithms enabled dynamic ball localization. Meticulous mechanical design ensured smooth movement, contributing to an immersive experience.

- ### Challenges Overcome

Success came with challenges, including lighting affecting ball detection. Iterative refinement and algorithmic enhancements mitigated issues. This underlined the importance of adaptability in robotics.

- ### Insights and Learning

The project highlighted interdisciplinary collaboration and technology fusion. Mechanical, electronic, and software components synergized for functional autonomy. Techfest engagement offered user feedback for future improvements.

Conclusion:

In conclusion, the Bluetooth-controlled Soccer Bot project serves as a testament to the harmonious integration of robotics and sports entertainment. Our journey, while marked with intermittent Bluetooth connectivity challenges, has been defined by unwavering determination and adaptability. These challenges have provided us with invaluable insights, spurring a relentless pursuit of innovation.

Looking forward, the project's success lays the groundwork for future strides. The exploration of alternative communication methods, coupled with a steadfast commitment to refining decision-making algorithms, promises to elevate the Soccer Bot's performance to unprecedented levels. This endeavor exemplifies not only our technical proficiency but also our commitment to enhancing human-technology interaction in the realm of sports.

As we reflect on our achievements, we envision a horizon brimming with possibilities. From enhancing user experience to redefining the boundaries of robot-human collaboration, the Bluetooth-controlled Soccer Bot project symbolizes a stepping stone toward a future where

technology amplifies the excitement and engagement of sports, ultimately creating a profound impact on how we perceive both robotics and recreation.

Acknowledgments:

Our gratitude goes out to Sheikh Saif Simran sir for their invaluable mentorship and guidance, which provided the Soccer Bot project with unwavering direction.

We also want to express our appreciation to our dedicated team members. Their collaborative efforts, diverse skills, and commitment to excellence were fundamental in bringing the project to fruition.

We extend our thanks to our CSE department for providing the essential resources and support that allowed us to explore the potentials of robotics in sports.

Our acknowledgment extends to the participants and volunteers who generously contributed their time and feedback, aiding in refining and validating the project.

Lastly, we recognize the constant encouragement of our friends and families. Your unwavering support has been a driving force throughout this journey.

As we conclude this project, we understand that its success rests on the shoulders of those who have played a part, directly or indirectly. Together, we've not only achieved our initial goals but also paved the way for future innovations and possibilities.