Somaiya Vidyavihar

K J Somaiya College of Engineering
(An Autonomous Un-aided Institute - Affiliated to University of Mumbai & Approved by AICTE)

TEAM KJSCE ROBOCON - Progress Report

January 2018 - August 2018

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TEAM MEMBERS:

1. Sahil Rajpurkar
2. Soofiyan Atar
3. Shreyas Borse
4. Bharathikumar Nadar
5. Ashwin Prajapati
6. Omkar Ghughe
7. Aakash Chothani
8. Ameya Konkar
9. Aniket Desai
10. Abhishek Kansara
11. Pragnesh Bhalala
12. Himanshu Bharakhada
13. Adil Shaikh
14. Maitri Desai
15. Neha Shethia
16. Pinak Jani
17. Monil Gada
18. Kartik Bhadesiya
19. Yogesh Chikhale
20. Kavya Moolya
21. Tanmay Dhasade
22. Ronak Bhanushali
23. Sumedh Manjrekar
24. Nilesh Gandhi
25. Prashant Joshi
26. Atul Tahiliani
27. Viraj Thakkar
28. Ritik Jain
29. Hritik Jaiswal
30. Vallabhi Kamalia
31. Shubhankar Riswadkar
32. Parth Shah

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Research & Development period:

The team has implemented the following things:

For precise movement of a full-fledged autonomous robot:

Succesfully tested and implemented Line Following using the following sensors LSA08,TCRT5000 , phototransistor.

Made our own line following module using opt101 and Atmega16.

Tested and Applied Fence following using SONAR, LIDAR and SharpIR sensors.

Made our own customized IMU(Inertial measurement unit) sensor using Accelerometer, Gyro, and Magnetometer and used SPI and I2C communication for controller-controller communication with AVR.

Interfacing with ARM architecture based microcontroller – STM32F as a potential replacement for AVR microcontroller.

Image Processing has been used for Object Tracking and trajectory mapping, lane following.

3-Dimensional Image Scanning has been done using Raspberry Pi, a camera and a LIDAR distance sensor.

Stability and control:-

1. Customised electronic braking relay circuit for a four/three wheel drive without the use of external brakes.
2. Vibration dampening using Sorbothane.
3. A stable flanged wheel assembly for the drive system.
4. Increased traction between the ground and the wheel for less power loss.

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Different Drive Systems have been tried like Swerve Drive, 4wheel X-drive, 3 wheel holonomic drive.

Interfacing of Arduino and Matlab has been achieved for PID Controller Feedback Simulation.

Interfacing new motors and motor drivers:-
1. Successfully implemented new Dual Channel Roboclaw Motor Drivers with its own personal user interface and Implemented these drivers on the robot.
2. Tested Autotuning and speed control function for synchronization of two motors.
3. Successfully tested Ampflow F24-150-24V motor for higher torque and speed of the drive system using self-made Rope Brake Drum type Dynamometer.

Hardware:-
1. Created a custom battery level checking module using the microcontroller.
2. Using epoxy based copper clad board for PCB making.
3. A new customized robot controller design and circuit development.
4. New motor driver design using Opto-Couplers for better shielding.
5. Implementation of various circuit design .eg. PDS

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Orientation and Workshop:

ORIENTATION:

An orientation session was conducted by the team on 12th April to spread awareness about the work of Team Kjsce Robocon and ABU-Robocon competition in our college.

A total of 40 students attended the orientation. After the orientation, the students where showed a demo with our autonomous robot about the actual scenario that happens in the competition first hand.

Workshop:

Team KJSCE Robocon had organized a 3 - day workshop on the topic "Robotics & Automation" from 13th June to 15th June for SE and TE students. There were 63 registrations out of which 47 students attended the workshop.

The first day of the workshop covered the mechanical aspects of building the robots and covered the following topics: actuators, power transmission systems, drive types etc.
Visual representation of concepts was done with the help of diagrams, videos etc which helped in the understanding of imaginative concepts.
The second day of the workshop covered the hardware aspects of robotics and basics of electronics, sensors, etc. were covered. The day was concluded with a 3 – hour long session of hands-on Arduino coding and sensor interfacing.
The third day comprised of a session on PID and its interfacing on Matlab with the graph plot feature. A small line following robot was used for PID demonstration. A session on objected detection and color detection with Image Processing was conducted. At the end of the third day, the TKR autonomous robot for 2018 was displayed and all the components used in the robot were explained to the students with detailed reasoning.
The workshop ended with Principal ma'am addressing the students and telling about the need for understanding robotics.
All the students who attended the workshop were given certificates and a training period.

Training Period and Brainstorming:

The training period was organized so that the students can get a hands-on experience of designing and building the robots. A mock brainstorming session was also organized. The students were given one of the past year's theme as a topic to apply whatever they had learned. Many students who had joined the training period are now working as team members.

The various projects developed in the training period include:
1. Pneumatic Catapult
2. 3-Axis Robotic Arm with Turn Table Mechanism
3. Stair Climbing Robot
4. High-Speed Roller Gripper
5. Cascading Lift Mechanism
6. Lift using linear guides and belt drive
7. 3 Pneumatic Gripper that actuates at the same time
8. Pneumatic shuttlecock mechanism self-dispensing gripper

Brainstorming for ABU-ROBOCON 2019:

Context

Participants invited to this discussion session were team members of Team KJSCE Robocon KJSCE faculties, Hon. Girish Kulkarni Sir.

This discussion had following goals:
1) Presenting approach of both the robots for the Robocon 2019 Competition.
2) Presenting the strategies for completion of task.
3) Presenting various ideas for manual and automatic bots.
4) Presenting different feedback systems.

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Contest Theme "GREAT URTUU"
Slogan: "Sharing the knowledge"

The concept of the contest:
 The mission of the ABU Robocon 2019 Ulaanbaatar is to deliver information fast by using a relay messenger system - the Urtuu, which was first innovated in the world by the nomadic Mongolians. For exchanging information in a long distance, Mongolians had been using the Urtuu system as a messenger for rest (feeding, replacing a horse, etc.,), and in some cases, relay to another messenger. By using the Urtuu system, a messenger was able to travel in distance of 400 kilometres per day. At present days, we are going through massive and abrupt development of exchanging and sharing knowledge and information. This Urtuu system was an important invention that opened a new door for us to exchange and share the knowledge in regardless of space. Based on this concept, ABU Robocon 2019 Ulaanbaatar is designed to promote the idea of "Sharing the knowledge".
A match is between Red and Blue teams. It lasts three minutes at most. Each team has one manual robot known as Messenger-Robot 1, and one automatic robot known as Messenger Robot 2. The automatic robot has four legs as of horses while wheels are not allowed. The

manual robot carries the Gerege as a testimony from the Khangai urtuu, which is the the starting point. It goes along Forest, Bridge, and crosses the Line 1 next to Gobi urtuu, which is the starting point of the automatic robot.

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After Messenger-Robot 1 reaches Gobi urtuu, Messenger-Robot 1 passes Gerege to Messenger-Robot 2 at Gobi urtuu. Once Messenger Robot 2 successfully receives Gerege, it can go along the Gobi area. Messenger-Robot 2 must go by four legs, like a horse, and cannot use wheels to move. Messenger-Robot 2 passes through Sand dune and Tussock, and directs to Mountain urtuu. After Messenger-Robot 2 reaches Mountain urtuu, Messenger-Robot 1 can enter Throwing zone to throw Shagai, and must earn 50 or more points. In case that Messenger-Robot 1 earns 50 or more points, Messenger-Robot 2 is allowed to climb the Mountain. Afterwards, if it reaches Uukhai zone and raises the Gerege first, the team is the winner, which is called "UUKHAI".

About the session:

TEAM KJSCE ROBOCON had organized a brainstorming session for discussing Robocon 2019 theme and rules. We had invited Principal, Girish Kulkarni sir and all faculty members of KJSCE for our brainstorming session.
The brainstorming session was inaugurated by Prof. A.A.PRABHUDESAI SIR. He proposed vote-of-thanks to all present faculties and Girish Kulkarni sir. He emphasized on keeping the robots as simple and practical.

In this session team members have represented their ideas in group of 5. We have created five groups containing five members from mechanical, coding and electronics side for brainstorming session. We divided the full task into smaller parts and assigned them to different groups. Each group has assigned one primary tasks like MR2 Bot, picking and throwing mechanisms and gerege passing between MR1 and MR2, etc. Apart from these primary tasks each has to represent their ideas for all the other tasks also.

Every team member noted down each other's ideas and we will be shortlisting this ideas to prototyping and designing based on practicality and simplicity.

Prof. Irfan sir has also guided us with his knowledge. He also explained two important building blocks of algorithm development i.e. estimation and control in feedback systems. He is ready to help us with such types of algorithms and effective feedback systems error calculation. Girish Kulkarni sir helped with mistakes and ambiguities in the ideas proposed by team members.

Prof. Irfan Siddavatam Sir explaining estimation and control

List of Participants

1) Prof. Avinash Prabhudesai
2) Girish Kulkarni Sir
3) Prof. Nitin Nagori
4) Prof. Irfan Siddavatam
5) Prof. Mahesh Warang
6) Team Members of Team KJSCE Robocon
7) Ex-team Members of Team KJSCE Robocon

PROTOTYPING and TESTING

In this Prototyping period, the ideas that were discussed in brainstorming event are fabricated and tested. This helps to analyse the real-world advantages and drawbacks of the mechanisms that were discussed about in brainstorming.

Autonomous Robot:
A total of 5 – 6 prototypes were made. Each had different actuating mechanisms and different gaits of walking. They were tested and the results were compared against each other. Strains at linkages, weight balancing and other factors were taken into consideration while comparing. The bots which showed the best and most promising results were worked on for improving them.

Manual Robot:
2 drive types were taken into consideration initially. But finally, 2 wheel swerve drive was adopted for the manual bot.

For throwing of the shagai,   3 different mechanisms were tested and the mechanisms which gave the highest success ratio in throwing the shagai and obtaining maximum points was used in the bot.
For picking of the shagai: A couple of mechanisms gave successful results but one had to be scraped because it had a risk of violating a rule given in the Rulebook published by ABU-Robocon.
Gerege passing: There were many great ideas discussed in the brainstorming session but only one was tested and it was best suited for the swerve drive.

COMPETITION DETAILS
This year the Robocon India competition is held by IIT-Delhi. They have divided the competition in 3 stages.

Stage1 :
Stage 1 required us to send a Proposal Paper which included a brief description about the working mechanism of the robots and the sensors and actuators to be used. We also had to send a CAD model of both the robots.
The results of stage 1 were declared on 28/2/2019. Team Kjsce Robocon has successfully cleared stage 1 with 83 points out of 100 and 13th rank . Now we are preparing for Stage-2

Stage-2:
Stage-2 is a Proof Of Concept stage. In this stage,we have to capture videos showing the working of the robots whose Proposal paper which was sent in Stage-1.

Final Stage:
The final stage will be on 16th June,2019 at IIT-Delhi.