International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 02 | Feb-2018 www.irjet.net p-ISSN: 2395-0072

Design and Fabrication of Swarm Robot

Loka sunder.S[1], Mageshwaran.K[2], Rajesh Kanna.P[3]

[1,2] UG Student,Bannari Amman Institute of Technology, Sathyamangalam, Erode 638401 India
[3] Assistant Professor, Dept. of Mechanical Engineering, Bannari Amman Institute of Technology, Sathyamangalam, Tamilnadu India-638401

Abstract - *Swarm robotics is a new approach to the coordination of large numbers of relatively simple robots. The approach takes its inspiration from the system-level functioning of social insects which demonstrate three desired characteristics for multi-robot systems: robustness, flexibility. Flexibility can be defined as the capability to adapt to new, different, or changing requirements of the environment. Flexibility and robustness have partly conflicting definitions. The difference between two occurs in problem level. When the problem changes, the system has to be flexible (not robust) enough to switch to a suitable behavior to solve the new problem. For instance, ants are so flexible that they can solve foraging, prey retrieval and chain formation problems with the same base self-organized mechanism. In this project Air Hockey robot is made as an application of swarm robot.*

***Key Words*: Motion Control, Relative movement, Arduino Controller, Wi-Fi Communication, Object tracking etc...**

1.INTRODUCTION

In this project work, a robot is planned to play a game with humans. The system is able to operate under the help of camera. The first goal is to track the motion and position of the puck. This project focuses on to manufacturing the robot without using any type of robotic arms instead using stepper motors for motion control. The system consist of forward and backward movement and left and right movement of the striker which is controlled by the stepper motors. The aim of this project work is to build up at a very low cost, highly efficient robot. The tests are performed on robot to confirm that robot operating very well and high efficient rate.

1.1 How it works

The smartphone´s camera is looking at the playing court. The camera´s captured data is processed in real time by the smartphone. Detecting the position of the puck and the "Pusher robot" (and according to the current location of all the elements on the court), your smartphone makes decisions and commands the Robot via WIFI.Your smartphone will become an augmented reality device, showing predicted trajectories and position of all the objects involved in this game. The Robot is locally controlled by the robots brain shield which dictates the speed and acceleration of the robot, sending the appropriate pulses to the stepper motors.

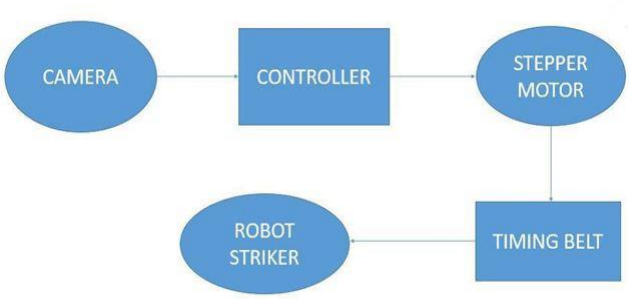

Fig -1: Block diagram

2. COMPONENTS

2.1 Arduino Leonardo

The Arduino Leonardo is a microcontroller board based on the ATmega32u4. It has 20 digital input/output pins (of which 7 can be used as PWM outputs and 12 as analog inputs), a 16 MHz crystal oscillator, a micro USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The ATmega32u4 has built-in USB communication, eliminating the need for a secondary processor. This allows the Leonardo to appear to a connected computer as a mouse and keyboard, in addition to a virtual (CDC) serial / COM port.

Here Arduino Leonardo controller is used for the fabrication of Air Hockey Robot. The purpose of using Arduino Leonardo is the availability of inbuilt data communication process. This helps in receiving the signals from Wi-Fi shield and send to the stepper motor.

Table -1: Specification of Arduino Leonardo

Operating Voltage	5V
Input Voltage (recommended)	7-12V
Digital I/O Pins	20
PWM Channels	7
Analog Input Channels	12

DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Clock Speed	16 MHz

2.2 Stepper Motor

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. Here NEMA 17 stepper motor is used and its specification is as follows.

Table -2: Specification of NEMA 17 Stepper Motor

Step Angle	1.8°
Step Accuracy	<5%
Holding Torque	45 N·cm (62oz.in)
Rated Current/phase	1.68A
Phase Resistance	1.65ohms
Voltage	12-24 V
Inductance	3.6mH±20%(1KHz)

2.3 Brain Shield

Arduino and Arduino-compatible boards use printed circuit expansion boards called shields, which plug into the normally supplied Arduino pin headers. Shields can provide motor controls for 3D printing and other applications, Global Positioning System (GPS), Ethernet, liquid crystal display (LCD), or bread boarding (prototyping).

This BRAIN SHIELD has:

- TWO stepper motor OUTPUTs
- TWO SERVO OUTPUTs
- I2C communications
- Push button
- SENSOR port (SONAR, IR…)
- ESP12-E (ESP8266) WIFI module (you can communicate to this SHIELD from any smartphone/tablet/PC using it)

2.4 Vision system

The coordinates of the puck and its trajectory are calculated using the visual data coming from the smartphone´s camera. Two consecutive frames are required in order to calculate the trajectory of the puck. The Air hockey robot uses its current location, the puck position and the trajectory prediction to determine its strategy– either defense, defense and attack, or a new attack. A uniform illumination is extremely important for the vision system. Avoid shadows, reflections (and if you can, fluorescent lighting).

3. WORKING PRINCIPLE

Mobile's Camera records the motion of the puck (Yellow colour) and identifies the coordinates consequently and sends the coordinates to controller using Wi-Fi signal. Then the stepper motors receives the signal from the controller and rotate accordingly. Robot's striker is attached with the timing belt of the stepper motor, Hence the striker moves both X and Y direction and strikes the puck towards the opponent. This cycle continues till the puck remains within the robot's region (Half of the table). Here only two stepper motors are used to control four directions. This is possible by connecting the timing belts in shape. When two motors rotates in clockwise direction the striker moves in Negative X-Direction, when two motors rotates in anti-clockwise direction the striker moves in Positive X-Direction. When left motor rotates in anticlockwise direction and the right motor rotates in clockwise direction the striker moves in Positive Y-Direction, when they rotate in opposite direction the striker moves in Negative Y-Direction.

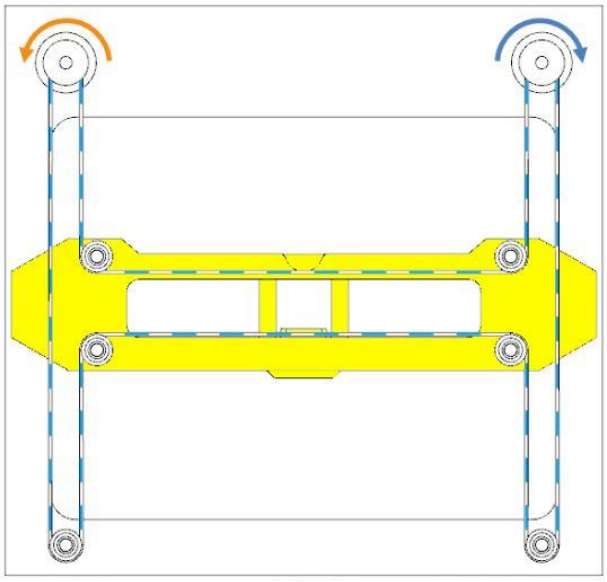

Fig -2: H-Structure of Timing belt

4. ASSEMBLY DRAWING OF AIR HOCKEY ROBOT

The CAD modeling is done and the assembly diagram of Air Hockey Robot is shown here.

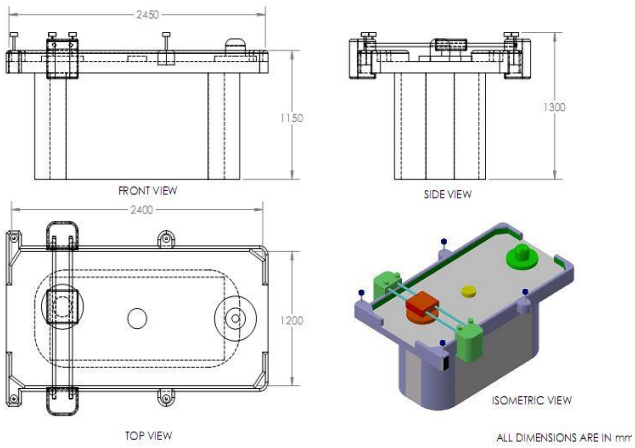

Fig -3: Design of the Air Hockey Table

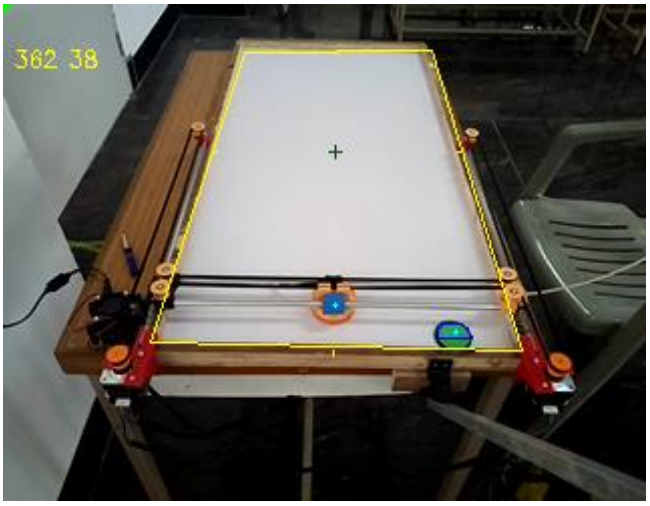

Fig -4: Working model of the Air Hockey Table

5. COST ESTIMATION

Part Number	Part Name	Quantity	Cost (in Rs.)
1	Stepper motor + cables	2 Nos.	3000
2	Arduino +Brain Shield	1 Nos.	1500
3	Stepper motor drivers	2 Nos.	600
4	Linear ball bearing	2 Nos.	1000
5	Stainless steel bar	2 Nos.	700
6	Aluminium square pipe	1 No.	600
7	Aluminium tube	2 Nos.	700
8	Timing belt	-	400
9	Bolts & Nuts	-	200
10	Wood & Mica sheet	-	3000
		Total	13,000

6. CONCLUSION

This design and fabrication on Swarm robot is aimed not only for entertainment but its principle can be applied in any kind of artificial intelligence techniques and the swarm robot has various kinds of applications such as Disaster rescue missions is one of the most important applications of swarms robots. Swarms of robots of could be sent to places rescue workers can't reach this would save lives. Swarm robots have many applications in mining tasks Swarms robots can be used in military to form an autonomous army. Swarm robots are also useful for autonomous surveillance and environment monitoring to investigate environmental parameters, search for survivors, and locate sources of hazards such as chemical or gas spills, toxic pollution, pipe leaks, and radioactivity. Swarm robots can perform tasks in which the main goal is to cover a wide region. The robots can disperse and perform monitoring tasks, for example, in forests. It can be useful for detecting hazardous events, like a leakage of a chemical substance. This project is the also another application and this kind of artificial intelligence can be applied anywhere and also in all sectors.

REFERENCES

[1] Adaptive task assignment for multiple mobile robots via swarm intelligence approach Dandan Zhang, Guangming Xie, Junzhi Yu, Long Wang Intelligent Control Laboratory, Department of Mechanics and Space Technologies, College of Engineering, Peking University, Beijing 100871, China.

[2] Cooperative Mobile Robotics: Antecedents and Directions Y. UNY CAO Computer Science Department, University of California, Los Angeles, CA 90024-1596 yu@cs.ucla.edu

[3] Cooperative Mobile Robotics: Antecedents and Directions Y. UNY CAO Computer Science Department, University of California, Los Angeles, CA 90024-1596 yu@cs.ucla.edu

[4] Arulampalam, M., Gordon, N., Orton, M. and Ristic, B.(2002). A variable structure multiple model particle filter for GMTI tracking. Proceedings of 5th International Conference on Information Fusion, 8–11 July 2002, Annapolis, MD, USA.

[5] Bar-Shalom, Y., Li, X.-R. and Kirubarajan, T. (2001). Estimation with Applications to Tracking and Navigation. NewYork, NY, John Wiley & Sons, Inc.

[6] R.C. Arkin, Cooperation without communication: Multi-agent schema-based robot navigation, Journal of Robotic Systems 9 (1992) 351–364

BIOGRAPHIES

Loka Sunder.S currently pursuing BE Mechanical Engineering at Bannari Amman Institute Technology

Mageshwaran.K currently pursuing BE Mechanical Engineering at Bannari Amman Institute Technology

Rajesh Kanna.P R Presently working as an Assistant Professor in the Department of Mechanical Engineering at Bannari Amman Institute of Technology
.