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AI Based Professional Real Time Game Board

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Abstract: ***The project aims to move the pieces on the board automatically according to beat the person in front and thus create an unique experience for a chess player. The strong structure consisting of various parts and sensors along with a fast processing unit. AI brings a completely new dynamic into the game as the machine will improve its game strategies with time opening a completely new prospect in the game. A motor-based system, along with smart magnetic detection provides a low noise and friction product at lower power consumption along with less wear and tear and even more effectively brings the cost of the product down sizably it helps in providing unique features such as hassle free motion of pieces along with unprecedented detection of moves are just some of the features the project aims to cover against the currently available similar products available in today's market. Also an improved size of the board along with aesthetically pleasing pieces is one of the feature the project aims to complete over its other competitors.***

Keywords: Artificial Intelligence, H-Bot, Arduino, Game Board

I. INTRODUCTION

Artificial intelligence is booming branch in technology which can be simply defined as ‘Any device /software that perceives its environment and takes actions that maximize its chance of successfully achieving its goals which is often compared to the "cognitive" functions that humans associate with human minds, such as "learning" and "problem solving". In recent years AI is successfully associated with applications such as understanding human speech, competing at the highest level in strategic game systems (such as chess and Go), autonomously operating cars, and intelligent routing in content delivery networks and military simulations. The project aims to combine both these entities to create a self-playing chess board which has the capacity to stand on its own as a playing unit for a single person without any opponent. The pieces on the board will automatically be moved on theboard according to AI to as the device will try to beat the person in front.

It uses powerful processors such an Arduino mega along with a stockfish engine. The Arm motion is carried out by 2 stepper motor with 1200steps/rev as the base joint. Forward and reverse kinematics will be used to easily provide accurate precise and simple motion of the robotic Frame. Thus, the project provides the real playing experience using modern technological tools and artificial intelligence

The chess is a strategy game played on an 8x8 grid on a checkered board. The game is normally played by 2 players, each of whom begins with Sixteen pieces of color palettes. The final goal seems to be to checkmate the opposing king by putting it in a position where it cannot escape being captured.



Fig 1: Chess Board

Checkers It is a strategy game for two players that involves diagonal moves of uniform game pieces and mandatory captures by jumping over opponent’s pieces.

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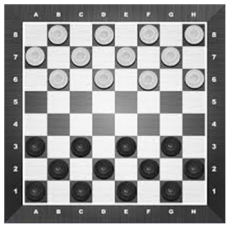


Fig 2: CHECKERS BOARD

The most basic game ever played is Tic Tac Toe. It is a simple game which involves filling up a 3x3 grid with X's and o's. The player who gets three X's or three O's in a particular row, column or diagonal first wins.

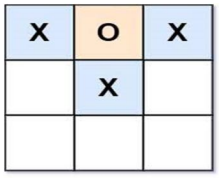


Fig 3: Tic-Toe-Tac Board

II. METHODOLOGY

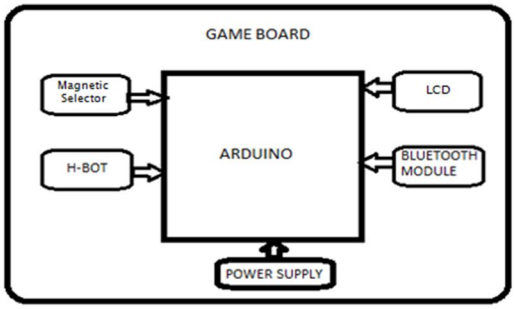


Fig 4: Block Diagram

As we can see in above block diagram our project consist of various configuration and moving parts which are like Arduino MEGA, Stepper motor(H-Bot Configuration), Bluetooth Module, LCD Display and power Supply. Here each one block has its own working principle and method of operation. All this components are configured on a big square game board.

A. The H-BOT Concept

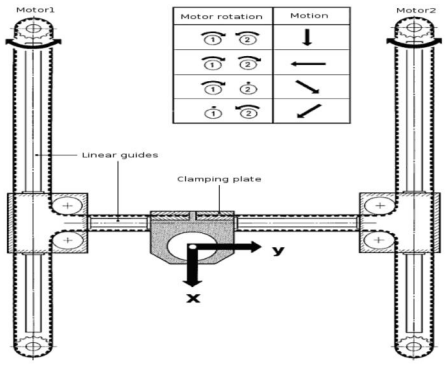


Fig 4: Schematic Of H-Bot Configuration

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This H-Bot concept represents the interaction of two rotary drives which are connected by a Single H-shaped circumferential timing belt around two staggered linear axes in a gantry type like configuration. Due to the fact that the drives do not have to be moved the achievable dynamic values can be quite high. Another aspect of this concept in contrast to delta-robot like kinematics is that the weight of the work load is carried by the linear guide ways and not by the drives. Also, the working envelope, the required transformations and the uniformity of the distribution of properties are far easier to handle for industrial use than the often-odd shaped working envelopes, complex kinematics and the strongly nonlinear property distribution of alternative concepts and the kinematic, numbering of bodies.

III. TECHNICAL REQUIRMENTS

A. Arduino MEGA

The Arduino is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a 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.

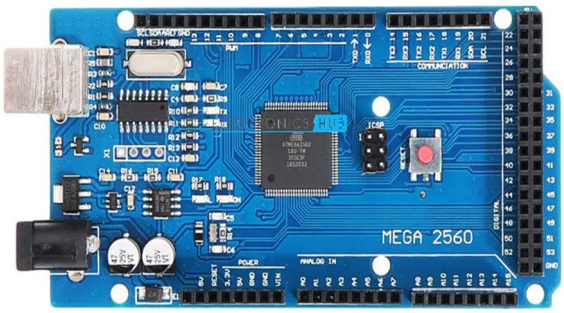


Fig 5: Arduino Mega

B. STEPPER MOTOR

NEMA 17 is a **hybrid stepping motor** with a 1.8° step angle (200 steps/revolution). Each phase draws 1.2 A at 4 V, allowing for a holding torque of 3.2 kg-cm. NEMA 17 Stepper motor is generally used in Printers, CNC machines and Laser Cutters.



Fig 6: Stepper Motor

C. Bluetooth Module

HC-05 Bluetooth Module is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

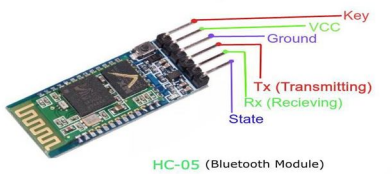


Fig 7: Hc-05 Bluetooth Module

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D. Stepper Motor Driver



Fig 8: A4988 Stepper Motor Driver

The A4988 driver is commonly used in 3D printers, CNC machines, and other projects that require precise control of stepper motors. It can control the speed, direction, and number of steps of a stepper motor, making it a versatile and reliable choice for motion control applications. The A4988 driver is designed to be easy to use and integrate into existing projects. It has a built-in translator that converts pulse signals into the proper motor driving sequences. It also features adjustable current limiting, over current protection, and thermal shutdown to protect the motor and driver from damage. To use the A4988 driver, you need to connect the stepper motor to the driver's output pins, and provide power to the driver and the motor. You also need to provide step and direction signals to the driver to control the motor's movement. Overall, the A4988 stepper motor driver is a popular and widely used driver for stepper motors due to its ease of use, reliability, and compatibility with a wide range of microcontrollers and development boards.

IV. IMPLEMENTATION & RESULT

In this project the main implementation is of hardware components and the conditional work is done by software part hence we will concentrate on hardware implementation, and its working in this chapter.
In hardware we use few components like Arduino Mega which is Atmega 328P based microcontroller which is the brain of our device and h-bot configuration which consist of Nema-17 Stepper motor , A4988 Stepper motor driver which is the key device used to move the pawn in xy direction and magnetic selector which is used to select the required pawn and lastly HC-05 Bluetooth module which is our RC communicator between the 1st user and the game board. We also included an LCD Display to display the game mode and pawn movements in all the directions.

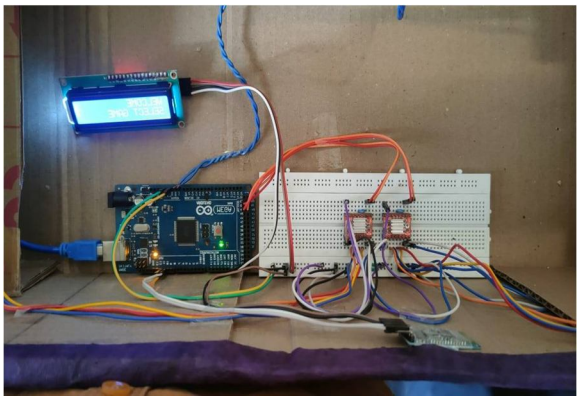


Fig 9: Internal Components Configuration

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We have initialized for 3 different games:

1) *Chess Game:* We can see the setup as shown in below figure.



Fig 10: Chess Game Setup

2) *Checkers Game:* We can see the setup as shown in below figure.



Fig 11 : Checkers Game Setup

3) *Tic Tac Toe Game:* We can see the setup as shown in below figure.

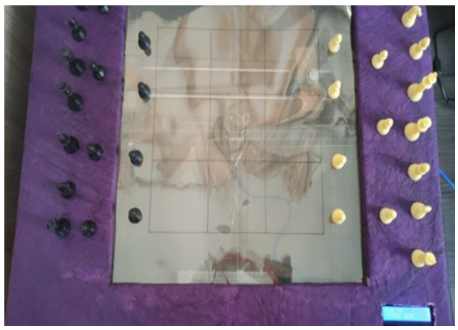


Fig 12 : Tic Tac Toe Game Setup

Let us also see the bluetooth configuration and Remote Control keys in detail

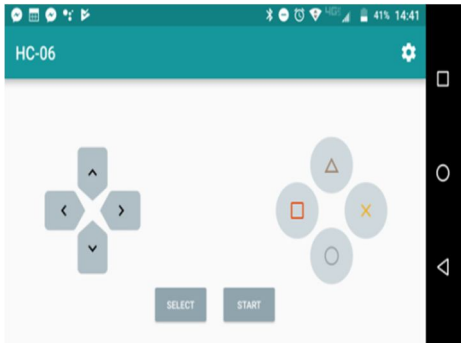


Fig 13 : Bluetooth Controller Mode Setup

Here each keys are configured with different functionalities:

> - Move Pawn Leftward
< - Move Pawn Rightward
^ - Move Pawn Upward
v - Move Pawn Downward

Start - To start and stop/draw the game
Select - To Select Game Mode

[] - To select Chess Game
O - To Select Checkers Game
X - To Select Tic Tac Toe Game
△ - To Draw the Match

Hence we can say that player one has the full control on game board in order to move the pawn as required so that player 2 can make a move accordingly and display the same in the LCD.

A. Results

Finally we were able to design a remote controlled based automated professional real time game board which is capable of moving the pawn itself by taking the commands or move direction from player one using bluetooth controller where the second user gets a new kind of experience and this is implemented for 3 different games namely, Chess, Tic Tac Toe and Checkers.

Let us see the output or working in below mentioned URL:
https://youtu.be/DedP6f0Z9VM

V. CONCLUSION

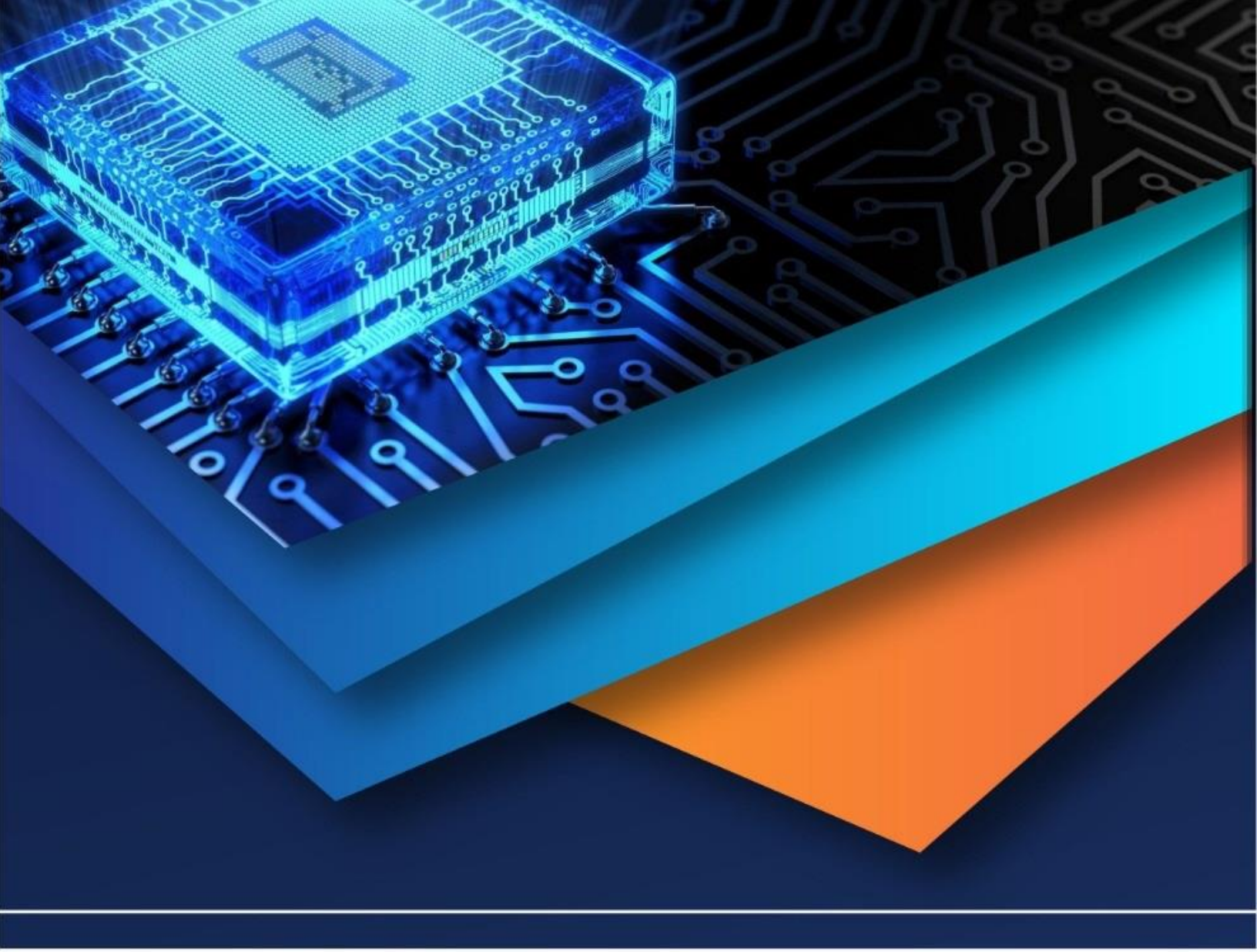
Finally we have proposed and implemented a system that can move a pawn when we give instruction from the Arduino bluetooth controller by the user. Here we can see that a professional real time game board which can be controlled by the player one using Arduino bluetooth controller.

VI. FUTURE SCOPE

With proper knowledge one can develop a system which uses AI for the pawn movement. Further we can design a system which consists of speaker which tells us the commands and other instructions. Later it can be used to implement various other board games. It will be useful in application where one cannot move the pawn physically but able to give command and etc.

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