Arduino based Wireless Powered Chess

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ABSTRACT: This paper concentrate on designing of chess boards using Arduino mega and Reed Switches. The Arduino is the open source platform. The normal chess procedure is just so sit next to each other and enjoy the game but if you don't find anyone near you to play, And if you find a person who has a same skills as you but live for five block ahead and can't come to your place to play and what happen when you are in hospital and you want to kill the time by playing the game. The wireless powered chess has solutions of all the problems. Already build system requires computer and laptop to enjoy the game which affects cost and complexity. In the result and simulation part this paper will focus to enjoy the game at distance.When we play an ancient and noble game of Chess, we grapple with ideas about honesty, deceitfulness, bravery, fear, aggression, beauty and creativity which echo the attitude we take up in daily lives. Chess is an activity in which we deploy almost all our available cognitive resources; therefore it makes an ideal laboratory for investigation into the working of human mind. This study will focus on automatically operated chess board with the help of Bluetooth and Arduino Processesor. In this process two chess boards are connected with the help of Bluetooth and by using Arduino processors the interfacing between the two boards is done. The idea to carry on this project is taken up from "Computer Controlled Chinese Chess" in which the program is written in visual basis (VB) language and the commands are given with the help of computer to microcontroller which manages the different RF receiver robots at RF frequency and moves the different major and minor pieces and performs the operation of castling .The Complete operation is done at RF frequency and the moves done on computer is perform on the board as well.
In the proposed wireless powered chess project, since both the chess boards are connected with Arduino Microprocessor, the move performed on manually attended boards is also seen on other board without operating by the player. This study of Wireless powered chess will facilitate playing chess sitting at different location in a limited surrounding.

KEYWORDS: Arduino mega 2560, Reed Switch, DC Motor, Linear Actuator, Drawer Bearing, Teeth and Gear.

I. INTRODUCTION

Chess is a game which was discovered before 800 years. It has been a favourite game in people of all ages. Though the game is complex one, it is based on approaching, threatening and capturing pieces until destination is reached. John Artise in **Chess and Education** states: "Visual stimuli tend to improve memory more than any other stimuli; chess is definitely an excellent memory exerciser the effects of which are transferable to other subjects where memory is necessary." The ancient and noble game of Chess is functioning state of mind and it grapples the ideas about honesty, deceitfulness, bravery, fear, aggression, beauty and creativity which echo the attitude employed in daily lives. Chess is an activity which deploys almost all the available cognitive resources; therefore it makes an ideal laboratory for investigation into the working of human mind. Chess utilizes all abilities of human being. It enhances spatial aptitude, perceptive speed, reasoning, creativity as well as general intelligence of a person. It was claimed that chess playing makes kids smarter and hence in many schools chess is made a compulsory indoor sports. But for playing chess two players need to be in front of each other. What if someday you are alone at home and want to play chess with a friend who is few kilometres away from you. What if there is a competition but a player could not reach at the desired place due to some unavoidable conditions. Wireless powered chess proves to be an excellent solution over these problems. The wireless powered chess is similar to the conventional chess that we play in day-to-day life. It has two players playing with two colour pieces. The way it differs from the conventional chess is that the players need not to be in front of each other for playing. The main elements of the system are Arduino Mega 2560, DC motors, reed switches and Bluetooth. The range of playing is dependent upon the Bluetooth module range.

This project focuses on automatically operated chess board with the help of Bluetooth and Arduino Processesor. In this process two chess boards are connected with the help of Bluetooth and by using Arduino processors the interfacing

between the two boards is done. The idea to carry on this project is taken up from "Computer Controlled Chinese Chess" in which the program is written in visual basis (VB) language and the commands are given with the help of computer to microcontroller which manages the different RF receiver robots at RF frequency and moves the different major and minor pieces and performs the operation of castling .The Complete operation is done at RF frequency and the moves done on computer is perform on the board as well. In the proposed wireless powered chess project, since both the chess boards are connected with Arduino Microprocessor, the move performed on manually attended boards is also seen on other board without operating by the player. This project of Wireless powered chess will facilitate playing chess sitting at different location in a limited surrounding.

II. NEED OF PROJECT

As we are looking around in the recent scenario all the people got addicted to the playing games on the cell phone constantly or the children's likes to play on computer or on the laptop. As a result of which the eye sight of all these people who are playing games on phone, personal computer (PC), and laptop got seriously damaged and they are force to wear spectacles in the small age.

Most of the times when we got bored at home or at hospital and a person is willing to kill the time but he don't find anyone near him to talk or to play without damaging his eyes sight and moreover while playing chess or any other indoor game you need a opponent which must have the same playing skill as you posses with you but if in case you don't find a person around you then you cannot play the game. Now a day's lots of chess application games are available to play on personal computer but they have the same drawback as mentioned.

III. RELATED WORK

A paper presented by **Konigsberg, Z.R** titled as "A combinatorial game mathematical checkmate control procedure for a class of chess endgames" in Control and Decision Conference 2008 [10], checkmate control procedure for a class of chess endgames was given. The class of chess endgames considered are those chess games that are built around a trebuchet, are just formed by pawns and, whose configuration can be decomposed as a sum of independent sub games restricted to belong to one of the following cases: i) zero or fuzzy games, and ii) positive or negative games where the winner has the possibility of driving the game to case (i). In addition some tempos were allowed. The main contribution consisted in answering the question of how a chess player checkmates knowing that he is in a winning position using combinatorial game mathematical tools. By a winning position in a game it is understood a position where one of the players makes the last move in that game and as a consequence forces his opponent to start playing in the next game and so on, until at the end plays first in the trebuchet and loses the chess game.

In a paper presented by **Kuo-Lan Su**, **Sheng-Ven Shiau** , **Jr-Hung Guo**, **Chih-Wei Shiau** named as **"**Mobile Robot Based Online Chinese Chess Game" [1],** in Innovative Computing, Information and Control (ICICIC), 2009 Fourth International Conference, the authors presented the game tree search techniques based on Chinese chess game, and use mobile robots to present the scenario. They design a mobile robot to be applied in many fields, such as entertainment, education and security. The mobile robot has the shape of cylinder and its diameter, height and weight is 8 cm, 15 cm and 1.5 kg. The power of the mobile robot is three Li batteries, and connects with parallel arrangement. It has three IR sensors to detect obstacle. The controller of the mobile robot is MCS-51 chip, and can acquire the detection signal from sensors through I/O pins, and receives the command from the supervised computer and the remote controller via wireless RF interface. The controller of the mobile robot can transmits the detection result to the supervised computer via wireless RF interface. The mobile robot can speak Chinese language using voice driver module. Authors develop the user interface of mobile robots according to the basic rules of Chinese chess game, and program the motion trajectories for the mobile robot to play the Chinese chess game. In the experimental results, mobile robots can receive the command from the supervised computer, and move the next position according to the attribute of the chess piece.

1) "A new representation of Chinese chess board" presented by **En-Lin Yang, Yong-Jin Liu, Ling-Xi Xie,** Published in **Computer-Aided Design and Computer Graphics, 2009, 11th IEEE International Conference** [11], overviewed that Computer-games research has opened a door to a multi-discipline domain across artificial intelligence, computer-aided design and computer graphics. Chinese **chess** is one of the most popular board games

worldwide and many researches on move generation, position evaluation, searching, opening and endgame play, have been developed. However, few works have been done in the basic representation of Chinese **chess** board. The representation of 10 times 9 integer array was widely used in Chinese **chess** programming. In this paper, based on concrete theoretical analysis, a new presentation of Chinese **chess** board with 6 long integers was proposed. Compared to the traditional 10 times 9 int-array representations that is often redundant in endgames, the cost of storage with the new representation is greatly reduced by an order of magnitude.

2) A paper published in Pattern Recognition, 2009, Chinese Conference titled as "Computer controlled Chinese chess"[6], a paper presented by **Lee, Dong-Sun, Wang, Shun-Jih, Pang, Heng-Yau** in **Computer Communication Control and Automation (3CA), 2010 International Symposium** (Volume:2), authors wrote a program in Visual Basic on a personal computer (PC) to move the chessmen of Chinese **chess** according to the Chinese **chess** rules. When the serial port of the PC is connected to a single chip microcontroller installed with a radio frequency (RF) **wireless** emitter, the emitter sends data to robot cars installed with an RF receiver. After a single chip microcontroller on each robot car analyzes the data, each robot car moves on a wood chessboard as its corresponding chessman does on the PC. The RF module fulfills the function of multiple communications, as the program enables six chessmen to move according to their respective moving rules, and their corresponding robot cars realize the moves simultaneously.

3) A paper Published in Pattern Recognition, 2009, Chinese Conference by **Peng Hu, Yangyu Luo, Chengrong Li** presented "Chinese Chess Recognition Based on Projection Histogram of Polar Coordinates Image and FFT" including chess detection and its character recognition, and the process should be fast and robust [12]. In this paper, Robert operator was used to get the edge information of chess, then detection, localization and segmentation of the chess were realized through mathematical morphology and template circle method. A new algorithm based on projection histogram of polar coordinates image and Fast Fourier Transform was introduced to extract the rotation-invariant feature of chess characters. Experiments proved that the algorithm can accurately recognize all chesses within 300 ms, and is robust to any rotation.

Intelligent Robots and Systems, 2009, IEEE/RSJ International Conference included a paper by Guofeng Tong, Ying Qu, Tong Cheng titled as "Human-computer interactive gaming system - a Chinese chess robot " [14], demonstrated the system of Chinese chess robot and it presents the latest development of artificial intelligence. The robot could play Chinese chess with human autonomously and it can recognize the pieces on the chessboard and move them with its mechanical arm. Furthermore, it has high intelligence which could approach the Â¿masterÂ¿ level.

Paper published by Xun Jiqing and Reiger Grimbergen titled as "Efficient time control in Chinese chess with alternating search" focuses on using available time more efficiently. A new method to improve the efficiency of time control by adjusting the search depth according to game stage and time left is proposed. [15]

The paper presented by Xiao chuan Zhang, Lianchang Chen, Fei Tu, Zushu Li in Control and Decision Conference (CCDC) 2011, named as "Discussion on Chinese Chess decision-making system with emotion[2]", analyzed the existing decision-making system of Chinese Chess computer game, and pointed out some of disadvantages. Then, a new three-level decision-making system of Chinese Chess computer game was constructed. In this decision-making system, affection computing was introduced. And the system achieved the high-speed searching and decision-making top-down though affection computing. Comparing with the existing decision-making system, the three-level decision-making system was proved workable.

IV. PROPOSED ALGORITHM

As we seen from our childhood lots of games come and die but the chess has its own meaning and usefulness. The game is of two players and builds in India over 1500years ago to teach various cognitive activities to the students related to the war field. In the proposed work two boards are build up and connected by the Bluetooth makes everyone enjoy the game at his own conditions.

Figure 1.shows the conventional gaming procedure for playing chess and Figure 2. Shows the proposed methodology

Figure no.1:- Conventional chess playing procedure.

Figure a   Figure b
Figure no.2:- a) Player 1   b) Player

In the proposed method as seen from figure two players are playing chess at different location with each other the followings steps are required to make board and interconnect them.
   1. Two boards should be of equal dimension and size is taken.
   2. Below the chess board in every white and block of chess box reed switch of 17mm is connected which are magnetic operated, every chess piece has to be fix with magnet at the bottom layer so that after placing the switch the reed switch must closed and if the cess piece is absent the reed switch comes into the original open state.

Figure no.3:-Reed switch and connection of reed switch for every block of chess.

   3. The movement of the chess piece is accomplishing by the linear actuator which is used to pick and drag the chess piece onto the board. The Linear actuator is nothing but the DC motor but the direction of motion is vertical. It can handle the load of 15kg onto it. On linear actuator strong magnets are connected which enables the contact with the chess piece magnet to drag to the respective co-ordinates.

Figure no.4:- (a) Linear actuator   (b) magnet at the bottom of Chess piece.

4. The motion in horizontal and vertical plane i.e. in X-Y direction is done by the DC motor of 30 R.P.M. The motors are fixed on the drawer bearing fixed on wooden plywood attached with teeth and gear help in to move freely to reach the respective locations.

Figure no.5:- (a) Dc motor with teeth and gear   (b) The complete assembly inside the system.

5. The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. The Magnetic reed switches are attached to the Arduino at digital input output pin and the Bluetooth module is at the Tx and Rx line.

6. The Bluetooth module used in this system is Hc-05 which is working in transceiver mode or master and slave mode. Two Bluetooth modules of two different boards are connected to each other and the sending Bluetooth module is
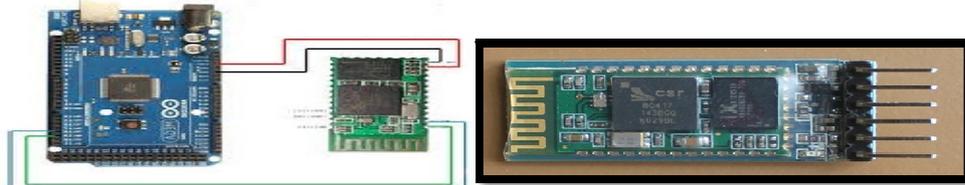

Figure No.6:- HC-05 and its connection with Arduino mega 2560.

Working as master and receiving module is working as slave.

7. LM293D IC is required to drive all the DC motors and pull up circuit is also requisite to provide proper current rating to each reed switch so that the close and open state must be provided.

A. *Design Considerations:*
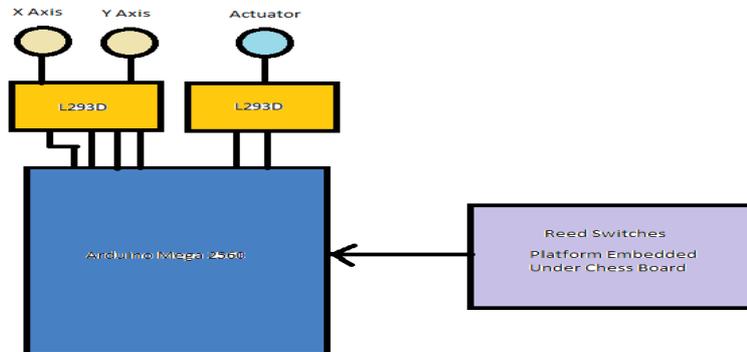
- 1.Block Diagram:-

Figure no.7:- Block diagram of the system.

In this project, the Arduino Mega 2560 is acting as a heart of the system. The magnetic reed switches acting as an input to the system, if the piece is placed on the reed switch that means the connection is closed and all the reed switches are connected to the digital pins of the board so depending upon the connections of reed switches the board will operate the motors to move in the x-y directions. The boards are connected with the help of Bluetooth module working in transceiver mode. When we play a move on board A manually between the reed switches, the board categorize the movement into source and destination. The co-ordinates will send by the Bluetooth module from board A to the Bluetooth module of board B. Now depending upon the coordinates the controller moves the X-Y motor to particular position and linear actuator will pick and drag the respective piece to corresponding position.

B. *Description of the Proposed Algorithm:*

Aim of the proposed algorithm is to enjoy the game of chess even though the opponent is not in front of you and the to make the game more interesting. The need to personal computer is completely eliminated so that if a person is not friendly with the personal computer or laptop he can enjoy the game while being in its own territory.

Algorithm for complete operation of two boards:-

FOR 1ST BOARD:-
- Initialize the DC motor to the default or initial positions and the linear Actuator connected to them as well.
- Scan the reed switches connected on the board in every block of chess for proper positioning and working.
- Now scan the reed switch after placing of the magnetic chess pieces and determine the closed contacted switch where the pieces have been placed.
- After determining the closed contacted switch where the pieces are store them into an "LOW" array.
- Scan the high or open contacted switch where the pieces are not present and Store the positions into a "High" array.
- Monitor the low array and check for the transitions from the low to high.
- If a piece is moved by the player then the Close contact turns into Open and high state occurs at the particular switch.
- If the transition is made then generate the code for the location from where the pieces is picked and store it into the "Source" variable.
- Now monitor the high positions and determine the position where the contact turns in closed one.
- If the transition is made then generate the code for the location from where the pieces is placed after picking and store it into the "Destination" variable.
- Now send the Source variable and destination variable via serial communication.

FOR 2ND BOARD:-
- Receive the data serially send by the 1st board.
- After receiving the data put them into source and destination variable.
- Find the X and Y coordinates for the source and destination.
- From the fetched co-ordinates move the X-Y motor to the respective location and bring it to the initial position as well.
- Again repeat from the first board.

V. SIMULATION RESULTS

Experimental results have proved the effectiveness of the project. The effective error rate is low and speed is moderate. In figure 1 the board is in the initial positions showing 2 board connected with the Bluetooth module. In the figure 1 the Bishop or castles is in the black box in the first row and same is on the board 2.

But when the player moves the Bishop manually on board 2, it also moves to same position in board 1 with the help of motors and actuators.

Fig.1.Chess with the initial position   Fig. 2After movement of piece

VI. CONCLUSION AND FUTURE WORK

- I have tried to make the project to the fullest. The proposed work is introductory part but efforts can be made to implement it with less error and low processing time. Further research in the field can reduce the number of connections required and increase the range of communication. Thus far, this project has been both challenging and rewarding. It is more apparent now how much work goes into a project of this magnitude, and there are still challenges to overcome.

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BIOGRAPHY

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