An-Najah National University

Faculty of Engineering

Computer Engineering Department

# WIZARD CHESS

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## DEDICATION

This is for you. For every person who ever helped. For every teaching member fight for us. For all family members. For colleges & friends. For every person who we cross path with in the computer department of An-Najah University on our way up to bachelor degree.

Thank you all.

## Acknowledgment

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## DISCLAIMER

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# Table of contents

# Table of figures

## Abstract

Chess, one of the most brilliant games ever played. It's been out there for too long and it becomes easily played on smartphone & PCs, along with AI capabilities for hard single play. Now what if we added technology to the physical chess board itself, the idea is to create a self-controlled chess pieces that moves with a support of underlying magnet that would give a feeling of fun wizard movement. The project has four turns, the board could be used to play with AI, the board can be used to play with someone else using internet connection or Bluetooth, or someone play with the board itself and the other with a smart device and finally it can be used to mimic the movements of chess championships.

# 1. Introduction

## 1.1 Problem Statement

With the evolve of technology, computation algorithms and CPUs. It becomes possible for a machine to play games efficiently against human like Chess, Fighting & Card games.

Now regards chess algorithms it reaches a point that it could be never beaten even against chess masters worldwide.

We see a lot if versions for chess games whether on PC, mobiles or tablets, But the new trend nowadays is that we need to feel these smart algorithm capabilities in real life not only on screens.

It becomes possible to build up a robot who can think, talk, move & play chess.

So the basic idea is to create a chess board robot to play chess physically with no additional robot arms only the board itself.

## 1.2 Objectives

The purpose is providing a self-playing board chess, that you could play against same as you do with any smart device. This board is adaptive smart and moves pieces in fun way that it feels like magic or the chess board we see in Harry Potter Movie, that's we the name of this project came from.

## 1.3 Scope of work & Importance

This project has 4 main ways to go for as the playing choices offered.

First, Playing against the board (against AI) as a single player with multiple hardness modes. Second, two player mode, first player uses the board and the second player plays from some smart device anywhere using internet (his chosen moves will be transferred across internet network to the board then the board mimics these moves). Third, two player mode but both uses same separate boards in different places. Both players will enjoy physical play and with friends. Fourth, the board could be connected to a going on chess contest and it will mimics all moves taken (It's like a live TV for chess contests).

Plus, this idea could be turned into a commercial business that manufacture wizard chess boards to sell.

Also chess is a two player strategy which limits the player desire in playing as a demand for a partner, although the spread of online chess games which enable you playing with computer or another partner through the internet, but still the playing on physical board carry a special entertainment.

# 2. Constraints & Earlier course work

## 2.1 Constraints

### 2.1.1 Lack of materials & equipment

There is a big lake of tools and equipment's in overall regards hardware tools & kits here in our country. And a great delay when some equipment's ordered from online markets. Also there is no place where we can design specific kits or circuits to be printed.

### 2.1.2 Time

This point is basically a result of the previous one. Plus, a lot of time is wasted searching for an idea and preparing how and which to use among controllers, and what will fits for our requirements.

## 2.2 Earlier course work

Courses which have been taken in the computer engineering department help implementing and developing this project like OOP, software engineering, web, network, digital 3 and pic which was very important to turn this project into life.

# 3. Literature Review

This project has some similar projects and products, but there are no open sources have been founded, so the project was done independently with no previous work. So in this section we will discuss some of similar existing products to wizard chess, like chess hand robot.

Chess hand robot consists of robot hand that responsible of the piece movement from one square to another as a response of AI movement (this project is a previous one in our department).

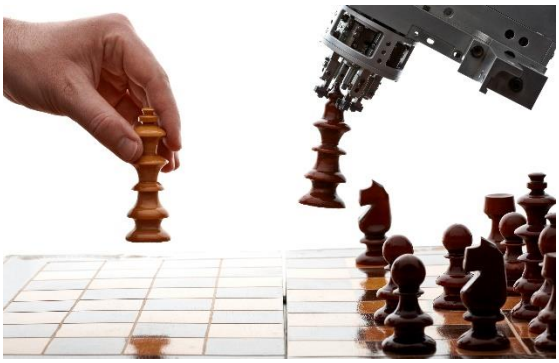

*Figure 1 (Chess Hand Robot)*

Also, there is a wireless Arduino powered chess that consist of two chess boards connected wirelessly which enable two users to play together in different location.

Wizard chess tries to combine features of different similar projects ideas to take the attention of user and help in improving skills playing for the user, in a fun and challenging way.

# 4. Methodology

In this chapter, we will discuss the tools and units that have been used in this project.

## 4.1 Equipment list

- 80 Hall effect sensors
- 80 Neodymium Magnets
- 2 Stepper Motors
- Guides
- Timing belts
- Arduino Mega
- Stepper motor 2A drivers
- 3D printed x-y table connecters
- 12V/5kilo Electric Magnets
- 12V/5A Power Supply
- Wood box
- 5 Digital Mux

*Figure 2 Hall Effect Sensor*

*Figure 3 Neodymium Magnets*

*Figure 4 Stepper Motor*

*Figure 5 Guide*

*Figure 7 Timing Belt*

*Figure 6 Arduino Mega*

*Figure 9 Stepper Motor Driver*

*Figure 8 Electric Magnet*

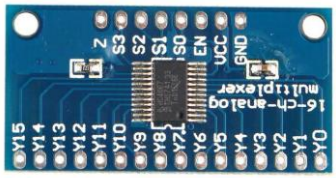


*Figure 11 Digital Mux*


*Figure 10 Power Supply*

This chess wizard consists of 4 main parts:

## 4.2 State & Sensors Part

This represent the sensing part, by default there is 64 chess squares that we need to identify and read signals from, to identify whether a chess pieces exists or not. Under each chess piece we add a Neodymium magnet to be able to move it later with underlying electric magnet and to identify if there is a piece in such square or not. Each square contains a Hall effect sensor in the middle that output 1 if there is no magnet field around and 0 if there is. Another 16 squares with sensors have been added to the board that represent the killing area of a chess piece. Five Digital multiplexer used to connect this network of sensors (each mux is a 16 pin input, 4 selectors & 1 output). These multiplexers needed because there are no enough inputs for 80 pins on Arduino Mega.

## 4.3 X-Y Table

This represents the muscles of the project. It consists of X & Y axis guides with 4D printed connectors in between. It also contains the main Electric magnet which is responsible of moving the pieces in the cross section of X & Y axis. Two stepper motors (2A) along with Timing belts where responsible of moving the Electric magnet, one for X axis and the other for Y axis. This kind of tables usually go with three small stepper motor to reduce tendency, but we used two (2A) big stepper motors instead. So the overall result is that this moving methodology is able to move to any chess square moving or killing pieces passed on the signal coming from controllers.

## 4.4 Controllers

Controllers represents the neural system of such project. In this part we have basically the Arduino Mega as a main controller. The Arduino is responsible to read the State of the five multiplexers to identify if a move has been made. Then it sends this new state to PC by serial communication and read back the move should be taken. It translates the needed movement, check if a kill is need, then send it to the drivers of stepper motors to apply the move then loop again the same scenario.

## 4.4 Stock Fish Chess Engine

This is the chess mind used to think. This is the most used unbeaten open source library of chess. It has been used with Python with the setup of serial communication with Arduino. The PC or code reads the state sent by Arduino, convert it from bit board (64 signals from multiplexers) to Forsyth-Edwards Notation (FEN) used by the engine, then decide which move should be taken and send it back to Arduino. The hardness level is decided by the time given to the engine to analyze.

# 5. Results & Conclusion

Wizard chess is a hardware project, magnetic control movement, gathers all new regarding technology in one board, which gives the user the opportunity to play with different modes & possibilities.

Wizard chess adds a type of innovation and attractiveness in playing which create more fun and modernity in chess board. Plus, it can be used to teach how to play chess by adding lighting capabilities to the board that would be used to show the possible move after picking up a piece or suggest movement to the user.

# 6. References


- https://github.com/official-stockfish/Stockfish
- https://www.arduino.cc
- https://www.npmjs.com/package/stockfish