HAND-EYE COORDINATION GAME

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1.Project Objectives

Aim of this project was to design a game to test for hand and eye coordination. All outcomes were met and below is a schematic that was used.

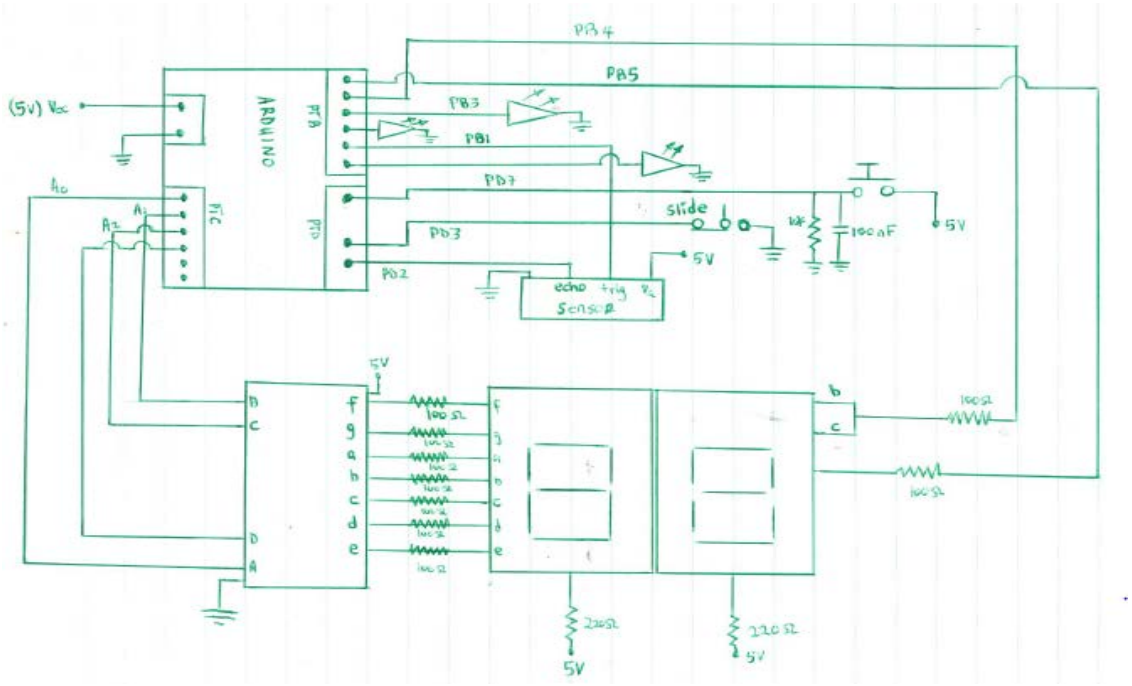

Figure1: Circuit that was used

Below is a table that shows what each pin was connected to and what it was used for.

Table 1: Circuit Explanations

Pin	How it is used	Explanations
Pins A_0 to A_3	Normal I/O	Outputs board region (from sensor) to the Decoder (SN74LS47N)
PIND2	INT0	Connected to echo pin to help capture rising and falling edge.
PIND3	INT1	Connected to slide witch to evoke an interrupt to go to play mode. Functions on toggle mode
PIND7	PCINT23	Connected to push button to cause an interrupt to go to test mode.
PINB0	Normal I/O	Connected to green led. Written to logic high whenever there is correct placement or positive overall score
PINB1	Normal I/O	Connected to trigger pin of sensor to trigger the sensor.

Pin	How it is used	Explanations
PINB2	Normal I/O	Red led to signify wrong placement or negative score
PINB3	Normal I/O	Orange led to signal no placement.
PINB4	Normal I/O	B and C segments of second led to display a carry if score is above 10.
PINB5	Normal I/O	Connected to G segment led to display hyphae if score is negative.

2.INT0, INT1, PCINT and Timers Used.

Interrupt zero was used to monitor and interrupt every time the echo pin goes high and low (toggle mode). It was used hand in hand with timer0. Timer0 was used as a counter to start counting upon the rising edge of the echo pin and stop counting on the falling edge. On the falling edge, timer counter value (TCNT0) was read and it is this value that was used as the distance. The timer was set to run at normal mode on a pre-scaler of 1024 so that every tick of the timer counter represents a cm or one division of the board region. From the data sheet it was deduced that the waves sent by the transmitter travel 58 microseconds per cm and therefore:

$T_{clock}(Time\ taken\ for\ each\ tick) = \frac{1024}{16\times10^6} = 6.4 \times 10^{-5} seconds$, Therefore: $\frac{64\mu s}{58\mu s} = 1.1 \approx 1$ (1)

From calculations above, it was concluded that each clock tick could represent one division with an inaccuracy of 0.1 which was very low. Considering that there would only be 8 regions on the game board, this means a total error of 0.8 in decimal which could not be carried to the decoder since the avr system works in binary.

Interrupt one was used to switch to the playing mode every time the sliding switch was used. Pin change interrupt 23 was used to switch to the test mode of the game. The addresses of INT0, INT1 and PCINT23 from the interrupt vector table are 0X0002, 0X0004 and 0X000A respectively. This means that that the echo pin interrupt can interrupt any of the interrupts, followed by INT1(play mode) which can interrupt PCINT23 (Test mode), thus switching from test to play mode made possible. Since interrupt with lowest memory address from vector table takes preference [1], this property made it possible to be able to measure the region values in both the modes since the sensor was triggered in both modes to take region values. Timer one was mainly used to create delays thus preventing overwriting important registers.

3.Pictures of Used Circuit

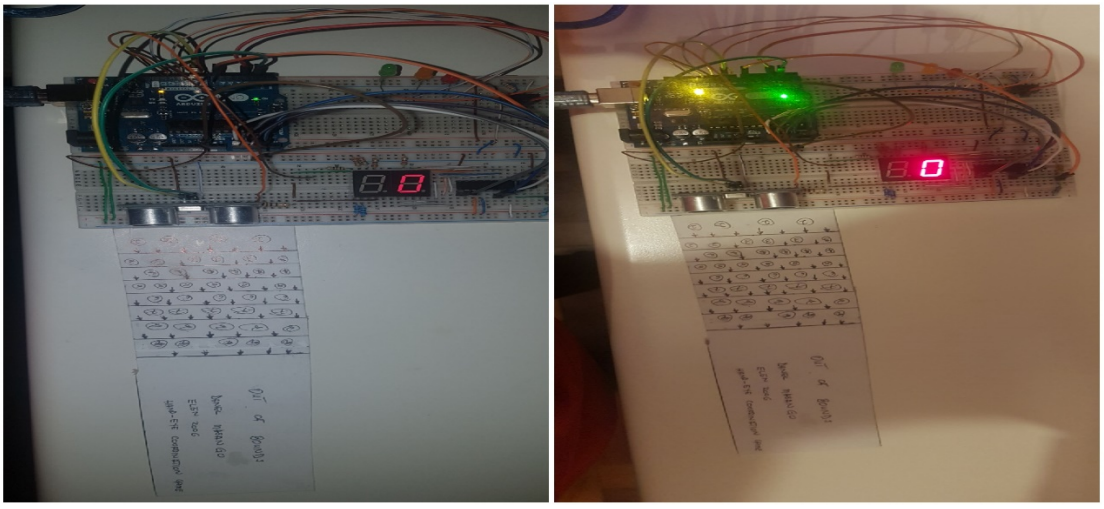

Figure 2: Picture of Designed Circuit

4.Flow Chart of Assembly Code

Presented below is a flow chart of the code that was implemented.

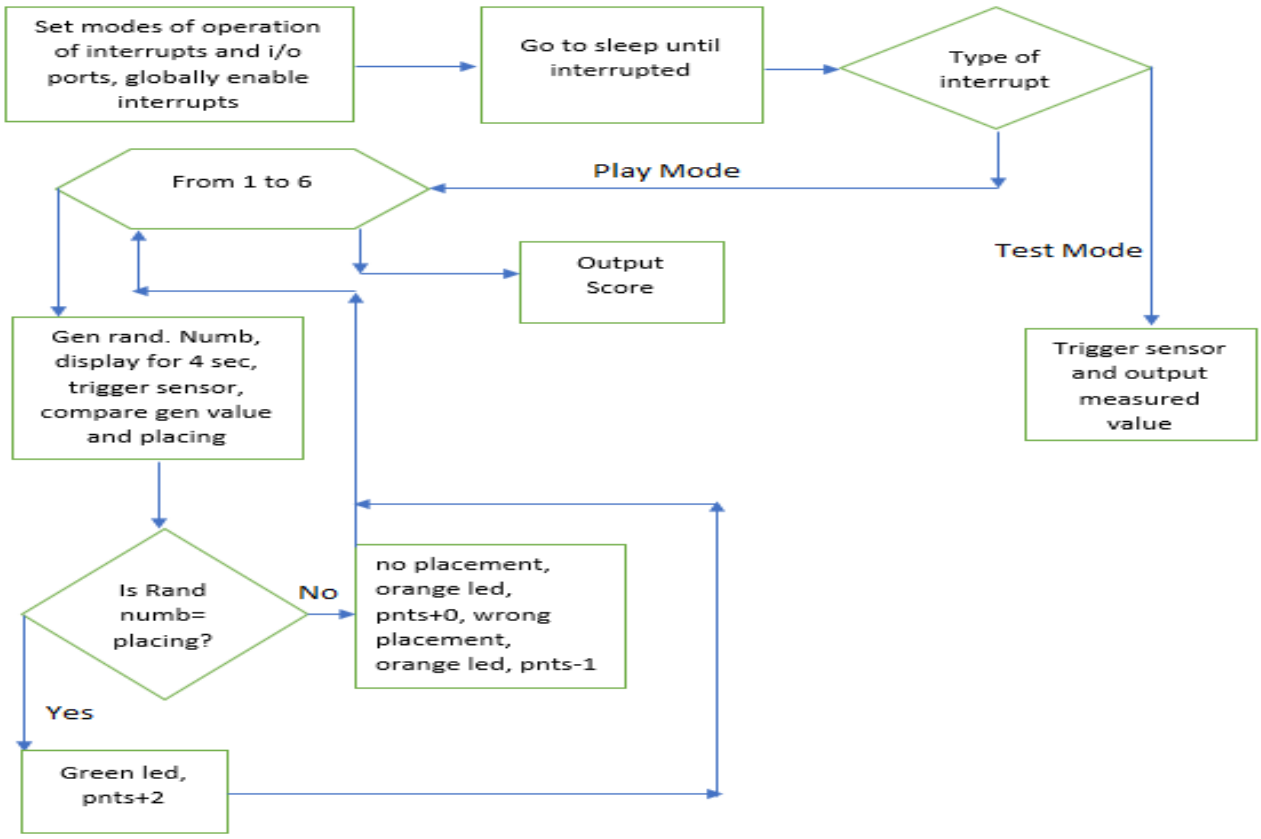

Figure 3: Flow chart of assembly implemented code

In addition to the debouncing RC circuit on the push button switch that was used, the pull up resistor for interrupt zero in portd2 was used. This helped in stabilizing floating voltages in the port thus preventing false interruption.

References

[1] Muhammad Ali.M, Sarmad Naimi, Sepehr Naimi, *The Avr Microcontroller and Embedded Systems*. Pearson Education Inc, New Jersey, third edition,2009.