

Final Project Report

Embedded System (IF3122)

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Nama Modul : Bowling Arcade Based On
Embedded System

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Lampung Selatan, 07 Desember 2021
Kelompok 13

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Abstract

1. Introduction

1.1 Research Background

During this pandemic era, almost every place is locked down and everyone is doing their daily activities at home. Some people sometimes feel bored with such conditions and need an entertainment to fill that saturation. There are several entertainments that can be done such as exercising, playing and others.

One of the entertainment that can be done is playing arcade bowling games. Bowling arcade is a game that aims to put the ball into the available holes, if the ball has entered the points will increase. The hole consists of three types that can be inserted balls, each hole has a different number of points. The player who gets the highest number of points will be declared the winner [1].

This game performs calculations manually so it will be less effective and will reduce the level of excitement of the game. This problem attracted the attention of our group to raise it as the title of the final project. In the final project, an embedded system will be created that can calculate points automatically. By using ultrasonic sensors, light sensors and PIR (Passive Infrared Sensors) this system can be made.

1.2 Research Question

According to the research background, research questions can be made as follows:

1. How to make the game automatically record points?
2. How to light up the bowling hole during a dark condition?
3. How do players receive balls to play the game?

1.3 Research Scope

This research border its scope in order to keep the discussion stay in topic. These are the research scope:

1. This research uses Arduino IDE to run its software.
2. The hardware in this research will be centred around Arduino Development Board.

1.4 Research Purpose

The purpose of this research are as follows:

1. To implement the knowledge that has been gained as an end product.
2. To make an entertaining game which automatically record scores for its players.

2. Theory

2.1 Arduino



Figure 1. Arduino Uno

Arduino IDE (Integrated Development Board) is an application compatible with different Operating Systems such as Windows, macOS, and Linux. Arduino IDE uses C and C++ language format to operate, it is integrated with many input and output functions. It is an open-source microcontroller-based development board that enables people to make interactive projects [2].

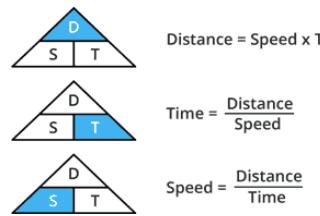
2.2 Ultrasonic Sensor HC SR04



Figure 2. Ultrasonic Sensor HC SR04

HC-SR04 ultrasonic sensor is a sensor used to measure distance using echolocation. The ultrasonic sensor has 4 pins which are Vcc, TRIG, ECHO, and GND. TRIG is a signal pin used to generate ultrasonic waves, while ECHO is a pin used to detect ultrasonic waves which are reflected. So in conclusion the TRIG pin is the pin that sends waves and ECHO is the pin that receives the reflected waves.

The reflected wave is then used to calculate the distance of the reflected object. This can be worked out by using distance-speed-time equations.



Note: Remember that waves are sent out and reflected back, so to get the distance you will need to divide your result in half [3] [4].

2.3 Passive Infrared Sensor



Figure 3. Passive Infrared Sensor

Passive Infrared Sensor is a sensor that can detect infrared rays and decode binary, decimal, and hexadecimal numbers. To decode infrared rays, you can use the IRremote.h library [5]. In this big task, the PIR sensor is used to detect the ball has entered the hole. If the ball is detected in, the points will be added according to the value stated on the hole.

2.4 Servo Motor



Figure 4. Servo Motor

Servo motor is an electronic component that can move, push or rotate at a certain angle. There are two types of servo motors, namely the standard type and the continuous type. The standard type is a servo motor whose rotation is limited to 180°. Type widely used in robotics systems such as Arm Robot / Robot Arm. While the continuous type is a servo motor that is capable of rotating 360°, an example of its application is in a robot car [6].

2.5 Light Dependent Resistor

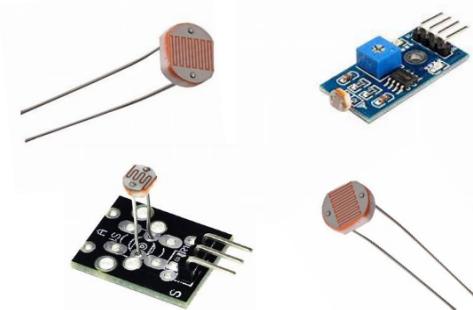


Figure 5. LDR

Light Dependent Resistor (LDR) is a resistor whose resistance value is determined by the intensity of the light it receives. The more light (bright) received by the sensor, the smaller the resistance value, and vice versa the less light (dark) it receives, the greater the resistance value. The output of this LDR sensor is an integer between 0 and 1023 [6].

2.6 Liquid Crystal Display (LCD) 16x2

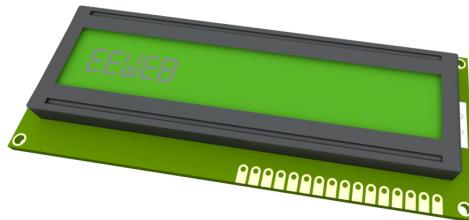


Figure 6. LCD 16x2

LCD (Liquid Crystal Display) 16x2 is a tool made of liquid crystal material that is used as a display medium. LCD 16x2 can display two lines with each line displaying 16 characters so that the total that can be displayed is 32 characters. LCD or liquid crystal display has several types of sizes such as 8x1, 16x1, 16x2, 16x4 and 20x4. The LCD in this project is used to display the timer of the game and display the number of scores that have been obtained by the player. The LCD will also display the words "Bowling Arcade Have Fun" at the beginning before displaying the score and timer [6].

2.7 Passive Buzzer



Figure 7. Passive Buzzer

Passive Buzzer is an actuator that can be controlled with a development board. To control the passive buzzer, first a pin declaration must be done. Then what is left to do is set the needed frequency for the buzzer [4].

2.8 Push-Button



Figure 8. Push-Button

Push-button is a component that connects two points in an electrical circuit when pressed (Arduino, n.d.). Push-button only have 2 conditions which are on and off (1 and 0) [7].

2.9 Light Emitting Diode (LED)



Figure 9. LED

Light Emitting Diode (LED) is a device that converts electrical energy into light energy. Colours emitted by LEDs are caused by their semiconductor material, for example red, yellow, green and blue. LEDs can also emit infrared light which can't be seen with the naked eye, usually used in remote controllers [8].

3. Hardware and Software Design

3.1 Hardware Design

In designing the hardware of this project, we will use the Arduino Uno as the main component, equipped with 3 sensors and 5 actuators. These components can be described in the architecture system as follows:

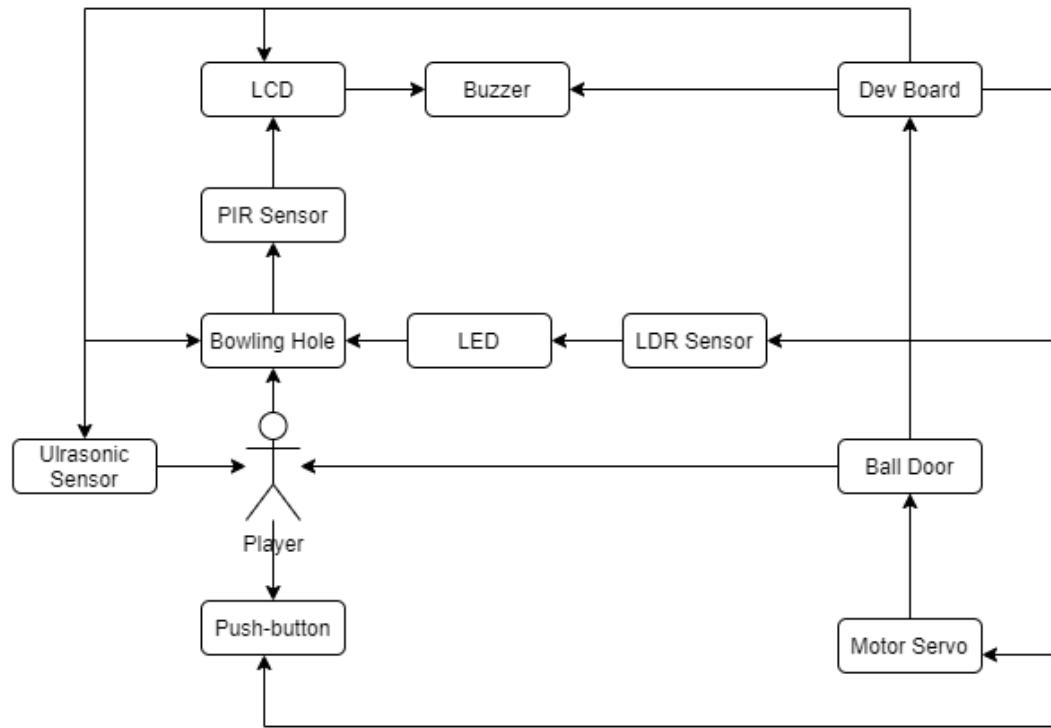


Figure 10. Hardware design of Bowling Arcade

In order for the sensor and actuator components to work, jumper cables are needed to connect the components with Arduino Uno. Arduino pin details can be seen in the following table:

Device	Device Pin	Arduino Pin
LDR Sensor	LDR	A0
LCD 16x2	SDA and SCL	A4 and A5
Ultrasonic Sensor	trig_pin and echo_pin	3 and 2
PIR Sensor	pin_pir	4
Servo	pin_servo	5
Buzzer	buzzPin	9
LED	pin_led and pin_led1	12 and 13
Push Button	pin_button	11

3.2 Software Design

In designing the software of this project, Arduino IDE is used to compile the source code to run the system. The flow of the system is designed as follows:

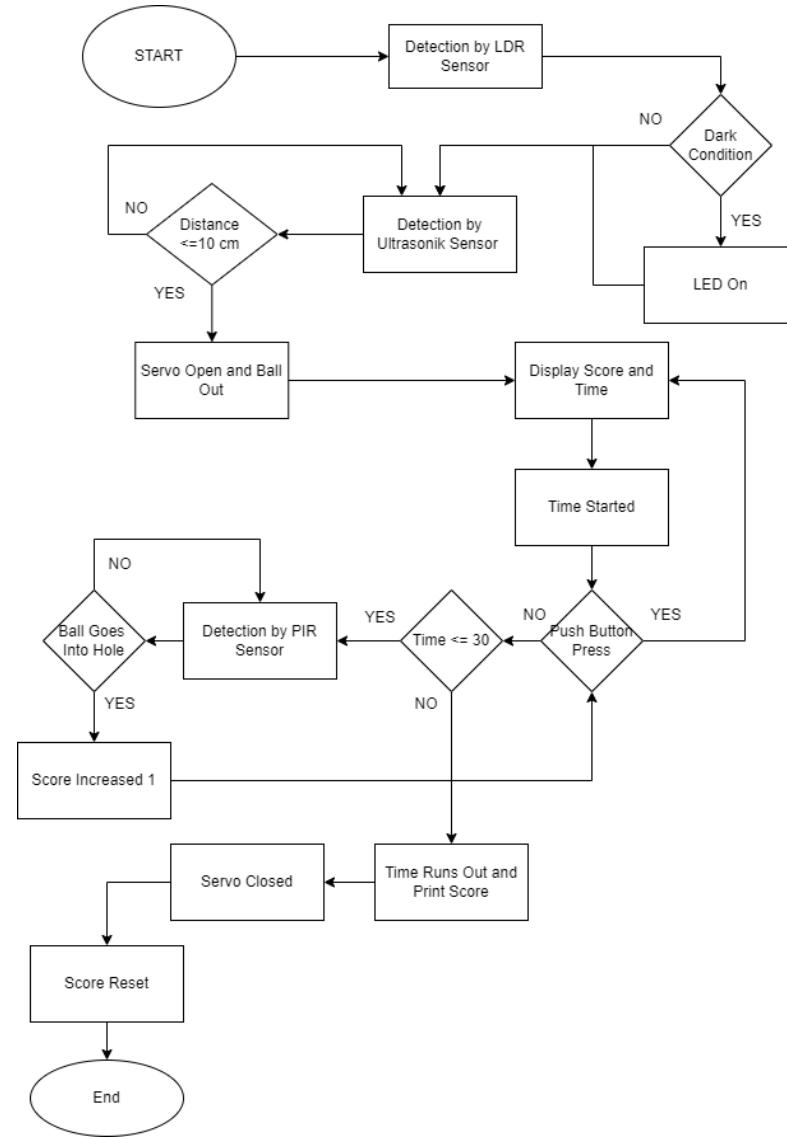
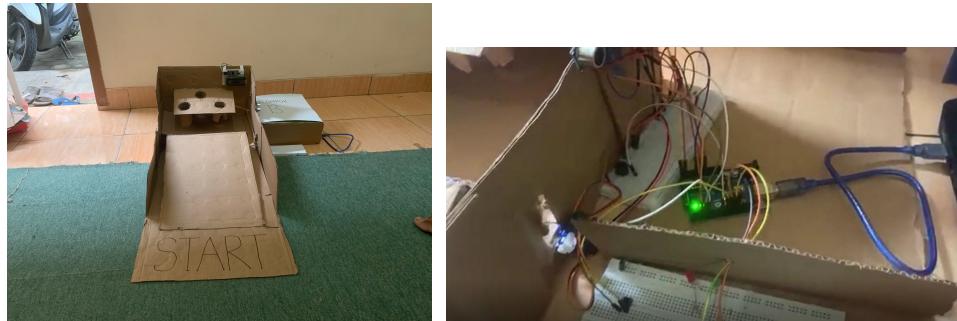


Figure 11. Software design of Bowling Arcade

4. Implementation and Testing

4.1 Implementation

At this stage, a simple arena made of cardboard that has 3 holes at the end. This arena is then put together with the pre-designed hardware. The source code is then uploaded to Arduino IDE for the system to work. The system views created are as follows:



4.2 Hardware Testing

To ensure the hardware is running, the device is tested, test results can be seen in the following table:

Device	Arduino Pin	Status
LDR	A0	Connected
LCD	A4 dan A5	Connected
Ultrasonik	3 dan 2	Connected
PIR	4	Connected
Servo	5	Connected
Buzzer	9	Connected
LED	12 dan 13	Connected
Push Button	11	Connected

Based on the test results above, it can be seen that all devices have been successfully connected to the Arduino Uno so it can be concluded that the hardware is ready for use.

4.3 Software Testing

Testing is carried out on the software that has been designed. Initial testing is done by making sure there are no errors in the compiled line of code and making sure it is successfully uploaded to the Arduino Uno. Furthermore, other tests were also carried out as follows :

Number	Action	Response	Description
1	Point hand in front of the ultrasonic sensor at a distance of about 3-8 cm	The ultrasonic sensor has succeeded in reading the hand distance seen on the serial monitor. Servo motor successfully moved to open the gate retaining the ball. The timer on the LCD starts to run	Succeed
2	Inserting the ball into the hole that contains the PIR sensor	The PIR sensor successfully detects the incoming ball which is visible on the serial monitor. The score on the LCD adds 1 from the previous value. The buzzer beeps every time the ball is put in	Succeed
3	Push-button press	System resets game score back to 0	Succeed
4	Set playroom lighting	Dark room condition causes the LEDs to turn on and bright lighting turns off the LEDs. This is caused by the readings of the LDR sensor.	Succeed

Based on the test results above, it can be concluded that the software embedded in the system has successfully worked as it should. Thus the system has been successful and is ready to be used as entertainment at leisure.

5. Conclusions And Recommendation

5.1 Conclusions

From the results of the design and testing of the Bowling Arcade project above, it can be concluded as follows:

1. The system built uses Arduino Uno as the main component as well as 3 sensors and 5 actuators. The main sensor of this system is the Passive Infrared Sensor.
2. This system is a ball type of game, with features capable of displaying game time and scores, being able to count the incoming balls in the form of scores and detecting movement to start the game.

5.2 Recommendation

From system design and testing, it still needs improvement in several parts. Suggestions that the author can give are as follows:

1. To maximize PIR sensor readings, PIR sensor should not be put in an enclosed environment.
2. It's also a good idea to add LEDs around the hole to illuminate it when it's dark. It would be interesting to see the LEDs blink when a ball enters a hole.

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