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Interactive Sport Court Lines using LED for Efficient Space Management

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Abstract: A sports complex or hall have different courts for different sports. However, a court will be a waste of space if rarely used. Thus, this study proposes a sport court line generation using LED to enable conversion of the same space into different sport court. A prototype was developed based on the Input Process Output (IPO) method, using Arduino UNO, P10 LED, HC-05 Bluetooth module, DMD Connecter, and jumper wires as the hardware, and Arduino and MIT App Inventor as the software. Testing was successful. Future works include installing passive infrared (PIR) sensor on the court surface to turn the LED off when the court is empty and adding a remotely controlled score board.

Keywords: Internet of Things, Arduino, MIT App Inventor, smart court

1. Introduction

Sport is human activity which involves physical movement of a group or an individual [1]. Usually, people play sports at sport courts because of the game rule and safety [1-3] of players and spectators. However, some courts are rarely used which results in waste of money, space, time, and energy.

Hence, this study proposes a smart sport court using Internet of Things (IoT). Interactive sport court lines emitted using Light-Emitting Diode (LED) through an application connected via Bluetooth. This results in efficient space usage because people can play various sports in one place by changing the court lines.

Table 1 compares similar projects that combine the use of Arduino, LED, and mobile application. Arduino Uno or Arduino Mega is used as the main component. Most of the projects used Arduino Uno as it requires less memory than Arduino Mega thus suitable for simple project. Most of the projects used LED matrix rather than LED strips because it is easy to maintain and modify the light. Thus, the authors decided to use Arduino Uno and LED matrix as the main components of the project as they positively affect the design, usage, and maintenance of the sport court.

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Table 1: Comparison between similar projects

Project	Hardware/Software	Advantages	Disadvantages
Interactive Court Lines [5]	• Used Arduino Mega • LED strip to display court line • IR and BMP180 sensor to read data • RFID to access court	• Secure • Save space • Score count	• High cost • Hard to modify
Android Score Board [6]	• LED Matrix to display score • Provide app to access score board	• Don't have to count score manually • Score readable from far	• Did not describe the details of Arduino used
LED Message Scrolling Display [7]	• Arduino Uno and GSM Module to send the message remotely • LED matrix to display message	• Wireless and noticeable	• Movement of text make it hard to read • Limited text display
LED Brightness Control System [8]	• Used Arduino Uno • LDR sensor and smart phone to control brightness and identify broken light	• Control light anywhere • Reduce power consumption	• Must have an internet connection

2. Materials and Methods

This study used input-process-output (IPO) model (**Figure 1**) which is familiar in information technology [9]. It comprises three main phases which are input, process, and output.

Figure 1: IPO model [10]

2.1 Input

Planning involves "screening, sorting, combining process that brings project requirements, features and function characteristics into transition from idea to solution" [10]. An interview with three staff from Pagoh Education Hub's Youth and Sports department was conducted to determine project feasibility and requirements.

2.2 Process

Figure 2 visualizes the design of the circuit. The hardware used are Arduino Uno Rev3, HC-05 Bluetooth Module, P10 DIP LED lights, and jumper wires. Jumper wires connect the LED with Arduino IDE. The hardware was assembled based on the design.

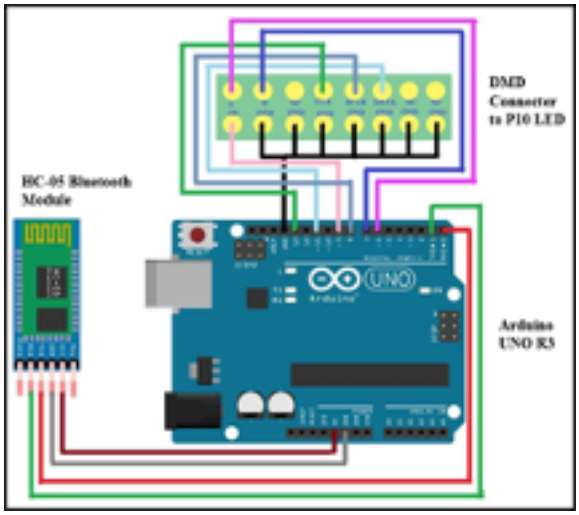

Figure 2: Circuit diagram

Arduino IDE was used to code (**Figure 3**), compile, and execute the program for the LED.

```
#include <SPI.h>
#include <DMD.h>
#include <TimerOne.h>
#include "SystemFont5x7.h"
#include "Arial_black_16.h"

#define DISPLAYS_ACROSS 1
#define DISPLAYS_DOWN 1
DMD dmd(DISPLAYS_ACROSS, DISPLAYS_DOWN);
char input;

void ScanDMD()
{
  dmd.scanDisplayBySPI();
}

void setup()
{
   Timer1.initialize( 5000 );
   Timer1.attachInterrupt( ScanDMD );
   dmd.clearScreen( true );

   Serial.begin(9600);
}
```

Figure 3: Code for LED

MIT App Inventor (**Figure 4**) was used to produce a mobile application that controls the device.

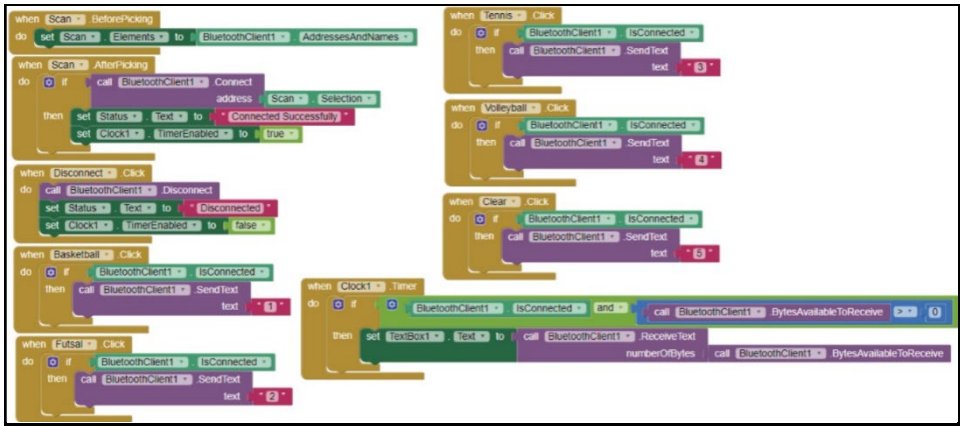

Figure 4: Code for mobile app

The prototype was tested by the developers to detect, find, and eliminate errors. It was then demonstrated to and evaluated by the staff from Pagoh Education Hub's Youth and Sports department via Google Forms.

2.3 Output

Figure 5 shows the interface of the mobile app. Users connect and disconnect to the device via Bluetooth by clicking the Scan and Disconnect button. They then select a sport by clicking the name of the sport. The device then projects the court line for the sport on the court surface (**Figure 6**). The Clear Court button closes the app.

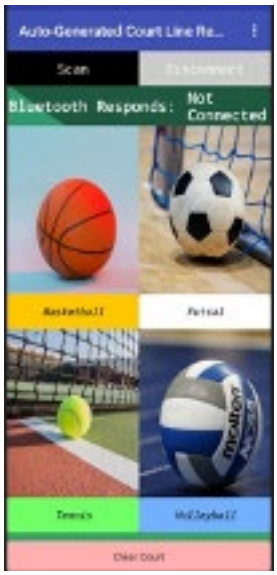

Figure 5: Mobile app

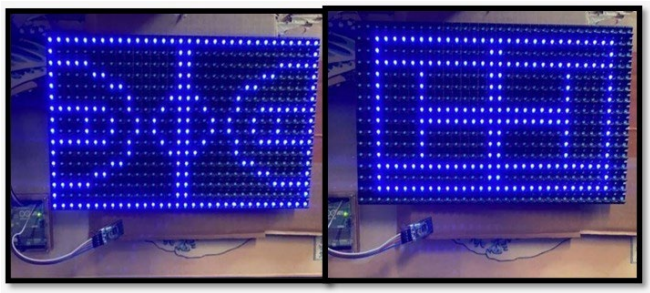

Figure 6: Line generation

3. Results and Discussion

Respondents concluded that the product is easy to use, user friendly, and sustainable. One concern is the need for smart phone as not all people who use sport courts have one. But apart from that, the respondents like the idea of the smart court and suggested that more research needed so that this project would be accepted and implemented.

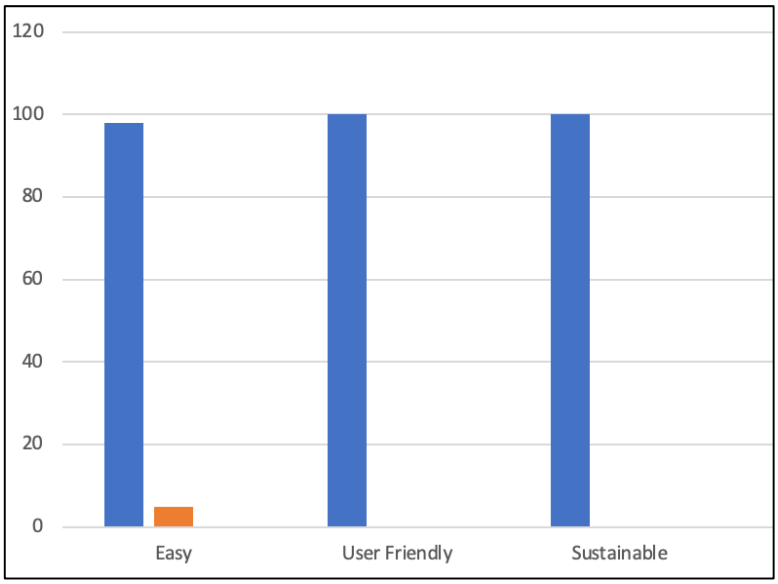

Figure 8: User feedback

4. Conclusion

Rarely used sport courts in a sports complex or hall is a waste of resources. Thus, this study proposed a smart sport court that uses an IoT device that generates court lines depending on the sport selected in a mobile app so that the same space can be used to play different sports. Comments from evaluators seems promising. Future improvements include installing passive infrared (PIR) sensor on the court surface to detect motion and turn off the LED when court is empty and adding a remotely controlled score board via the app.

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