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|  | **AGH University of Science and Technology** |

Report on the project

**Baba Jaga patrzy**

For classes

**Design Laboratory**

Elektronika i Telekomunikacja, 3rd year

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# Project’s goal

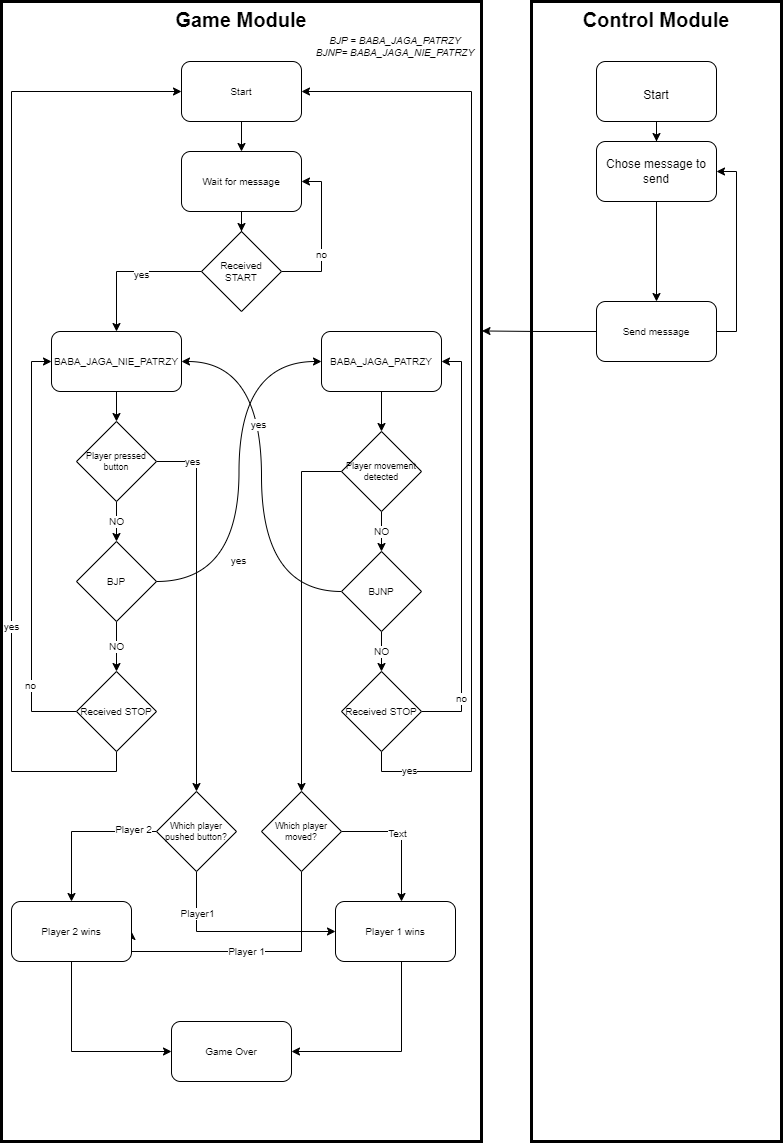
Goal of the project was to create hardware-software system which is the implementation of the real-life game *“Baba Jaga Patrzy”.*

# Design assumptions

* 1. **System functionality**

Game system is divided into 2 modules communicating via common Bluetooth interface:

* Game Module - core of the game, if initialized can be in 2 states:
  + *BABA\_JAGA\_PATRZY –* detects players movement and reports it,
  + *BABA\_JAGA\_NIE\_PATRZY –* detects pushed buttons and reports it.
* Control Module – allows to send 4 different messages to the Game Module *START, STOP, BABA\_JAGA\_PATRZY, BABA\_JAGA\_NIE\_PATRZY*. Depending on the message type specified action are taken by another module:
  + *START* – initialize the game,
  + *STOP* – finish the game,
  + *BABA\_JAGA\_PATRZY –* change the game to “*BABA\_JAGA\_PATRZY”* state,
  + *BABA\_JAGA\_NIE\_PATRZY* - change the game to “*BABA\_JAGA\_NIE\_ PATRZY” state.*

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*Picture 1. Game mechanism block diagram.*

* 1. **User Interface**

The game is designed for 3 players: 2 contestants and a game master.

The game master is responsible for controlling the game flow: starting/stopping the game and enabling/disabling movement detection.

If game master initializes the game, green diode lights up and keep on until the end of the game.

Contestant’s goal is to arrive to the location of the button and to push it before another player – first to do so wins. Contestant must watch out for the state of red diode. If it lights up, both players must stop and do not move. Otherwise, the contestant whose movement is detected, loses.

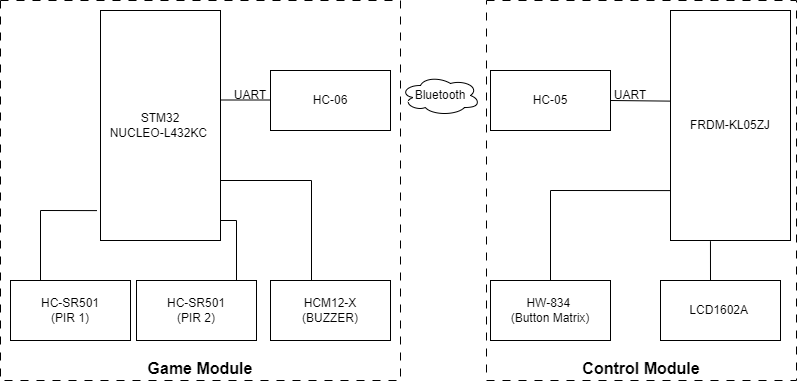
After player pushing the button or sensors detecting movement, high pitch sound is to be heard. One of two diodes (yellow corresponding to player no1 and green for player 2) lights up to inform who is the game winner.

* 1. **Hardware**

*Table 1. Electronic elements chosen for project implementation.*

|  |  |  |
| --- | --- | --- |
| Element name | Module | Application |
| STM32 NUCLEO-L432KC | Game Module | Controls game flow, PIR movement detectors and all other game peripherals (buzzer, diodes), receives data from HC06 Bluetooth module |
| FRDM-KL05ZJ | Control Module | Sends messages to Bluetooth module HC05, based on pressed buttons, displays data on lcd |
| HC-05 BLUETOOTH MODULE | Control Module | Master of Bluetooth communication, transmit messages from Control Module to Game Module |
| HC-06 BLUETOOTH MODULE | Game Module | Slave of Bluetooth communication, receive messages from Control Module |
| HC-SR501 PIR MOTION DETECTOR | Game Module | Detects movement when Game Module is in *BABA\_JAGA\_PATRZY* state and reports game rules violation |
| HCM12-X BUZZER | Game module | Plays sound when game ends |
| LCD1602A (with I2C expander) | Control Module | Displays messages, currently transmitted to Game Module |
| HW-834 4x4 BUTTON MATRIX | Control Module | Pressing button corresponds to sending predefined messages |

Datasheets of elements are to be found in project’s Git repository. Apart from listed components, other such as diodes, push button and resistors were used.



*Picture 2. Project’s modules block diagram.*

* 1. **Software**   
     Main functionality of Control Module’s program is to handle button matrix interrupts and transmit messages over UART to HC-05 Bluetooth module.

Game module’s program:

* handles interrupts from PIRs which detects players’ movement,
* lights up appropriate diode to inform players about game status,
* receives messages over UART form HC-06 and based on the input turns on or off PIRs’ interrupts.

Both Game Module and Control Module application were chosen to be written in C, using STM32CubeIDE.

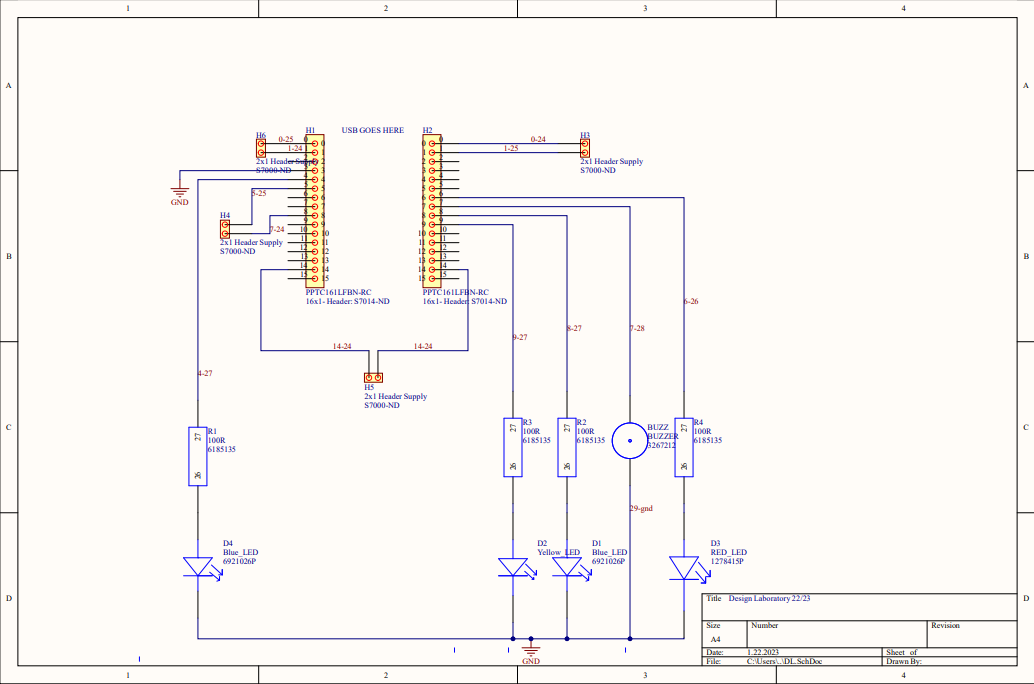
# Project Realization

Both modules have been designed according to presumptions described in previous part 2. *Design assumptions.* However, during integration process issue concerning HC05 and HC06 modules has occurred. There has been problem with entering command mode on Bluetooth modules, thus with pairing device for wireless communication. To mitigate impact on whole project and to ensure feature of wireless game controlling, new solution has been proposed: to substitute intended Control Module with simple mobile android application.

Created app has all assumed functionality and from user perspective is easier to use.

* 1. **Game Module’s electronic schematic and PCB layout**

Game Module’s elements were connected according to the schematic in the *Picture 3.*



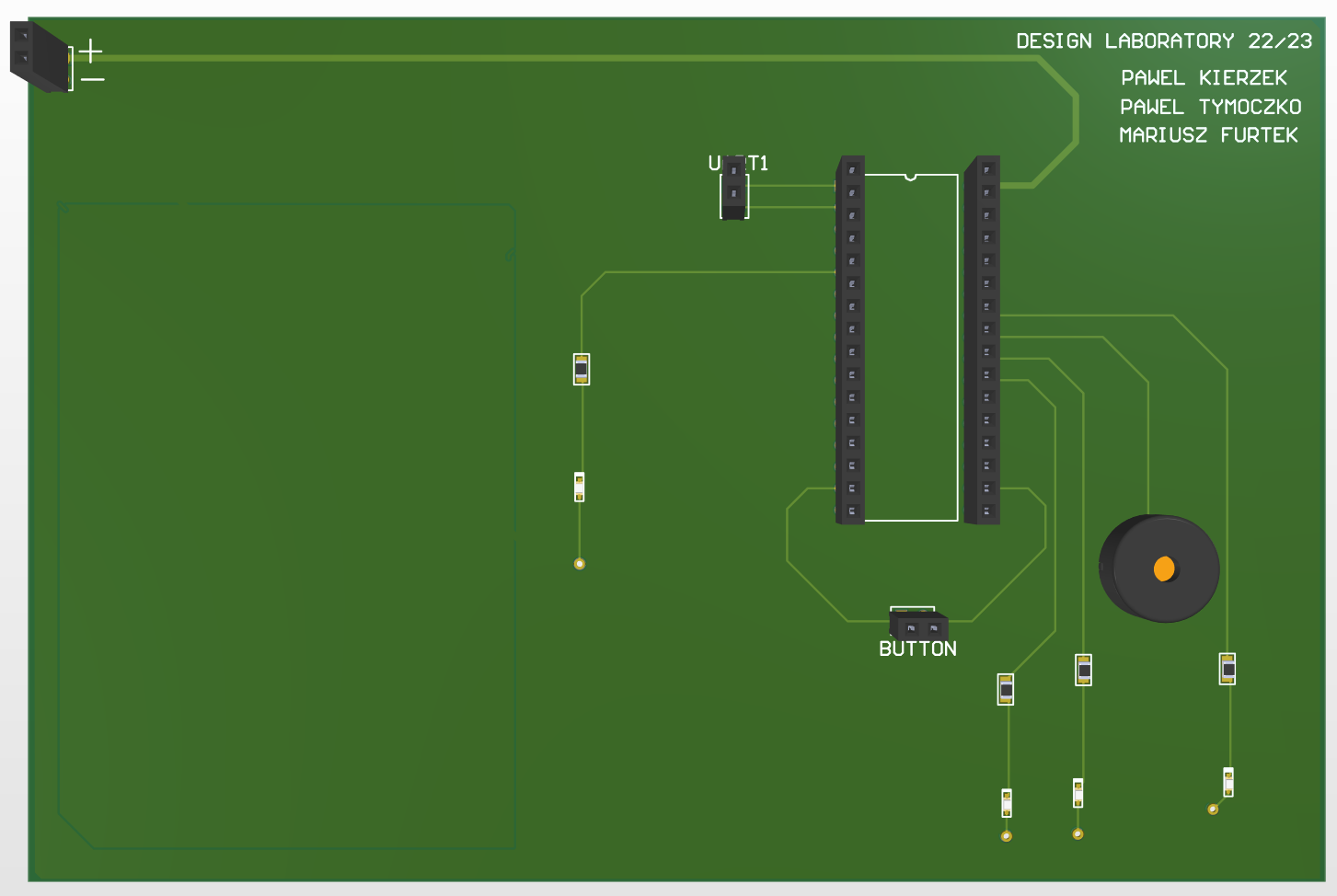
*Picture 3. Game Module electronic schematic*

On the schematic both PIRs and push buttons power on have not been put. PIRs are powered on according to the datasheet specification to +5V and GND and push buttons are connected to the power supply +5V.

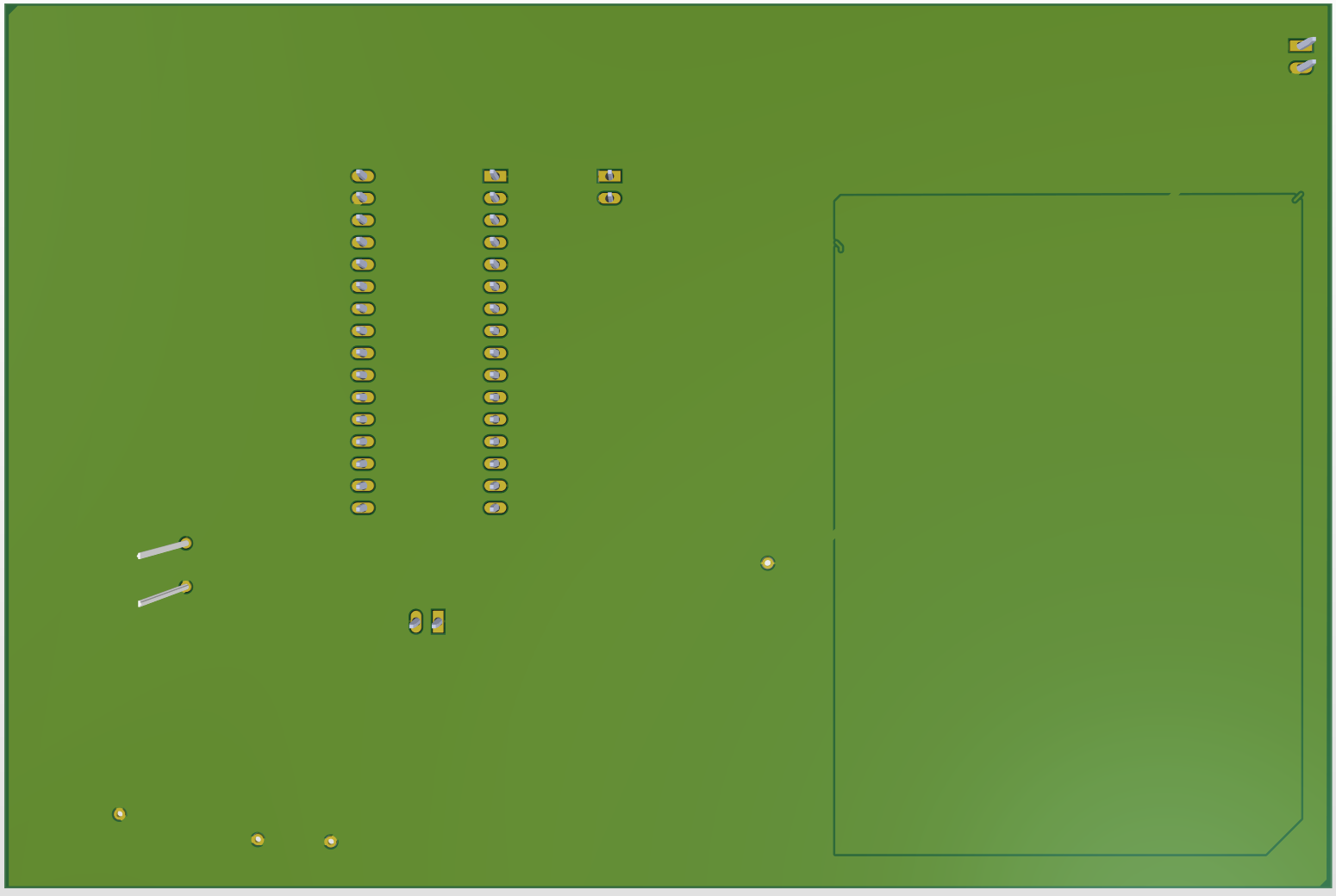
Based on the electronic schematic attempt at creating PCB layout has been made. Unfortunately, created layout correctness has not been confirmed with necessary analysis.  
Obraz zawierający tekst, sprzęt elektroniczny

Opis wygenerowany automatycznie

*Picture 4. PCB Layout attempt*



*Picture 5. Expected frontside PCB 3D visualization.*



*Picture 6. Expected backside PCB 3D visualization.*

* 1. Game module software

*Table 2. Used GPIO pins, their configuration mode and functionality.*

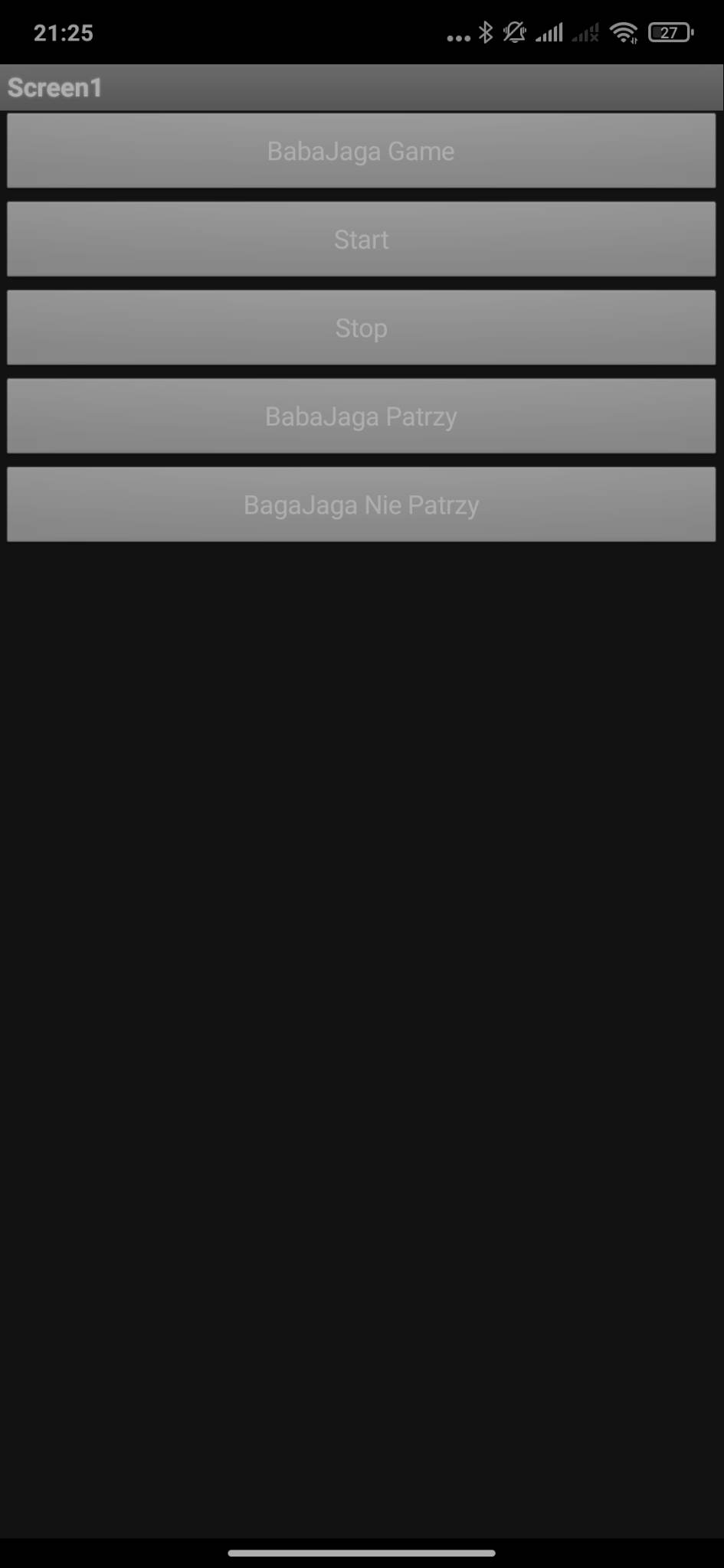
|  |  |  |  |
| --- | --- | --- | --- |
| Pin name | User labels | Mode | Function |
| PB0 | PIR\_SIG1 | External Interrupt Mode with rising edge trigger detection | Receives information about detected movement by PIR1 |
| PB1 | PIR\_SIG2 | External Interrupt Mode with rising edge trigger detection | Receives information about detected movement by PIR2 |
| PA3 | PIR\_OUT1 | Output Push Pull | Lights up yellow diode if player 1 wins |
| PA4 | PIR\_OUT2 | Output Push Pull | Lights up green diode if player 2 wins |
| PA6 | BABA\_JAGA\_PATRZY | Output Push Pull | Lights up red diode if Game Module is in BABA\_JAGA\_PATRZY mode |
| PA5 | BUZZER | Output Push Pull | Generate sound if game finishes |
| PA12 | GAME\_ON | Output Push Pull | Lights up green diode when game is initialized |
| PA10 | USART1\_RX | UART | Enables Bluetooth communication with Control Module |
| PA9 | USART1\_TX | UART |
| PB3 | BUTTON\_1 | External Interrupt Mode with rising edge trigger detection | Receives information if player no. 1 pressed button |
| PB4 | BUTTON\_2 | External Interrupt Mode with rising edge trigger detection | Receives information if player no. 2 pressed button |

All pins above are configured to the appropriate mode and initialized in Game Module program’s main function.

In the program game loop, program is waiting for new messages from UART1. If new message is the same as one of defined below, it takes corresponding action:

* START – ‘A’: initializes the game, reset all diode pins and buzzer pin, clear players’ score, light up GAME\_ON diode, set state to BABA\_JAGA\_NIE\_PATRZY,
* STOP – ‘B’: finishes game, reset all diode pins and buzzer pin, clear players’ score,
* BABA\_JAGA\_PATRZY – ‘C’: enables PIRs interrupts to allow movement detection,
* BABA\_JAGA\_NIE\_PATRZY – ‘D’: disable PIRs interrupts,
  1. Control Module mobile application

The application has been created using MIT App Inventor online tool in Scratch programming language. It allows to communicate with HC-05 module and send defined Game Module messages.



*Picture 7. Screen shot of Control Module App GUI*

* 1. Workflow and labor division

The project’s workflow and labor division are to be found in the spreadsheet named *workflow.xslx* in git repository.

For project management and team organization Trello Kanban board was used.

# Resources

* 1. Project resources
* GIT repository: <https://github.com/Pawlicho/DesignLab-BabaJaga>
* Trello Kanban board: <https://trello.com/b/rw4OTdqo/baba-jaga-patrzy>
  1. External sources
* MIT App Inventor: <https://appinventor.mit.edu/>
* CAD footprints: <https://www.digikey.pl/>