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IPSC Training System

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Abstract

The IPSC training system consists of three parts. The first is the User Interface (UI) which is used to contact between a user and a target controller. The user can control the action of the target following a set pattern by using FriendlyARM Micro2440 development board that also has an LCD screen, touch screen interface and other ports. Secondly, a protocol is used as a standard of communication between Zigbee network for the user interface and target in serial communication and using stop and wait ARQ protocol. Third, Target and target controller receive instruction via XBee following by Zigbee protocol. Target detects shooting using vibration sensor form Piezo transducer that has a minimum period at 250 milliseconds. When the target detects vibration that is high up to reference will control motor down according to target that have motor. IPSC Training System provides function to accommodate training in IPSC sport and IPSC competition.

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Keywords : IPSC, Shooting, ARM, Micro2440, FriendlyARM, Embedded, Piezo, XBee, Zigbee, Sport

1. Introduction

Nowadays, recreational shootings is very famous in Thailand especially with the use of BB GUNs which are developed to become very similar to real guns in appearance, component, weight, reflection of force and instruction. People who trained with BB GUN will increase their shooting skills. But in Thailand, most of the training yards, with real guns and ball bullet guns, have only fixed targets which cannot maximize the shooting efficiency of the user. If we apply the IPSC training system to airsoft shooting training, shooting efficiency will become better. For example, skills in shooting while moving, obstructive shooting, decision making, strategy response planning and timing will be improved. The training will not only be used in strategic shooting-training in sports or games, but it can also be implemented in other fields such as, self defence or protection training, training police and soldier to improve their shooting skills, etcetera. Consequently, we have invented airsoft shooting training system which becomes more modern for research and development. The development of airsoft shooting training system can also produce personnel who will gain knowledge in computer hardware that can be apply in real life situations such as creating a good product by controlling all parts of hardware.

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2. Principles and theory

2.1 FriendlyARM Micro2440

FriendlyARM Micro2440, an ARM9 S3C2440 processor, is one of the development board used to implement several works in embedded system. FriendlyARM Micro2440 consists of SDK Board and Stamp Module. The Stamp Module contains NAND flash, NOR flash, SRAM, CPU, etc. The SDK Board contains LCD, Resistive touch panel, Serial port, DC jack, USB port, SD card, etc. This board needs to be installed by the following list for run the system. All of these are done on Ubuntu 10.4.

- Install cross toolchain (arm920-eabi)
- Build and install uboot for using sd card to boot
- Build kernel for Micro2440
- Build and install file system for Micro2440
- Build Qt 4.7.4 library for Micro2440
- Install psplash program for your own booting picture
- Build the linked file to run system program automatically

2.2 Piezoelectric

Receiving mechanical force, Piezo transducer generates voltages between ceramic disk and outside disk. Because signals occurred by mechanical force are AC signal, these signals have to pass through the sensor circuit to convert AC signals to pulses. When an AC signal voltage is equal or more than the voltage reference, it will interrupt PIC Microcontroller to inform that the target is hit.

2.3 Zigbee

Zigbee is an international standard used to communicate via wireless network that has low throughtput, less power and cheap. Zigbee can create a network referred to IEEE 802.15.4 standard. There are three different types of Zigbees separated by its characteristics. Coordinator, build and set up the network. End Device, the final device in the route. Router, receive and send data in the route.

2.4 XBee

XBee is a device that has microcontroller and RF IC inside used as a transceiver-receiver device. And also XBee is a powerless device and easy to use via UART (TTL). There are two series of XBee, Series1 and Series2. And there are also 2 different types of power transmission, normal (having 1-2 mw) and PRO (having 50-60 mw). The PRO can send data farther than normal one. XBee operates within ISM 2.4GHz frequency band.

3. Design and Operation

Design and operation of the system are devided into three parts; Target and target controller, protocol for communication between user interface and target controller, user interface that is used to contact with user.

3.1 Targets and Target Controller

In IPSC training system, we separate targets into four patterns. First, Popper target is a target that will fall down immediately when it is shot. Second, Falling Plate Target is similar to Popper target, but the difference is that user needs to specify numbers of shot before falling down. Third, Classic Target is a target that has three areas for scoring and those areas are represented as A, C and D. Forth, Plate is similar to Falling Plate, but the difference is that it will not fall when it is shot. All of these targets have 2 patterns. First, the target that can be

shot, which is brown in color with zinc 1.5 mm. Second, the hostage target that cannot be shot, which is white in color with zinc 1.5 mm. If the hostage target is shot, the score will be deducted.

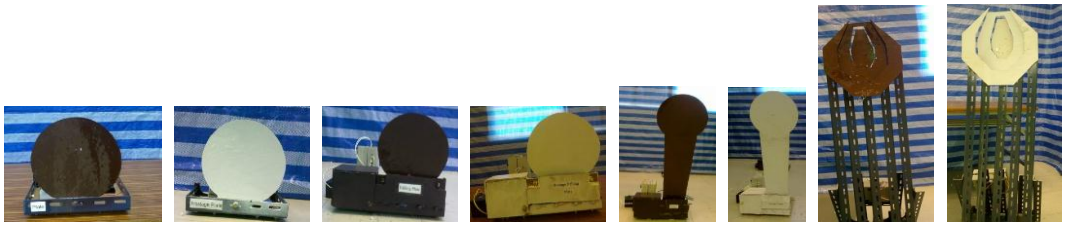

Fig. 1. Plate, Hostage Plate, Falling Plate, Hostage Falling Plate, Popper, Hostage Popper, Classic, Hostage Classic

Every Target has a target controller that is separated into three board types. First, Plate Target controller board is a board controlling Plate target type. Second, Classic Target controller board is a board controlling classic target type. Third, Motor controller board is a board controlling falling Plate Target and Popper Target type. Every target has threshold to specify how strong mechanical force is when bullet hit the target.

3.2 Protocol for communication

We have designed the packets for communication between target controller and user interface which are embedded in the RF data field on XBee API Mode. There are four XBee API Packets used in this system: the Transmission Request, Transmission Status, Received and AT Command.

The following packets are embedded in the RF-data in the above API Mode packet.

1. “Finding targets” packet is used to discover all of online target.
2. “Description target” packet is used to report target description.
3. “Setting 1” packet is used to send the configuration for Popper target type.
4. “Setting 2” packet is used to send the configuration for Falling Plate, Plate and Classic target type.
5. “Shooting Report” packet is used to send the position that was shot.
6. “Start Game” packet is sent out from FriendARM Micro2440 when user pressed START button.
7. “Stop Game” packet is sent out from FriendlyARM Micro2440 when user pressed STOP button or end of game.
8. “Change Target Description” packet is used to change description of the target.

3.3 User interface

Users need to log in to use the system or register if they do not have an account. After logging in, users can select any stage that they want to play by selecting the stage list. Then the “Check” button is pressed to discover all of the targets used for this stage. Figure 2 shows the stage picture and description that describe what users have to do. When all targets are online, users can connect to Start the game.

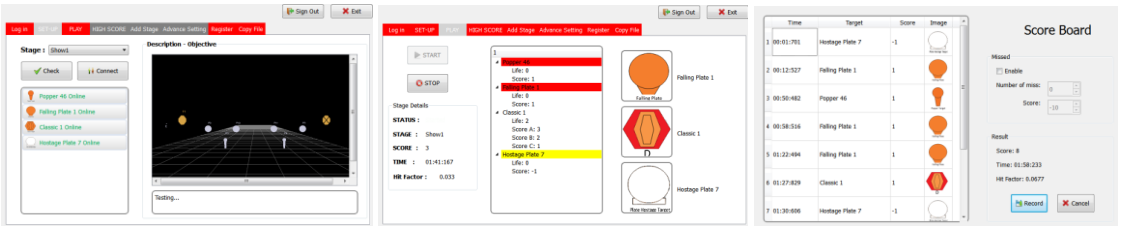

Fig. 2. Log-in and Register tab image

When users want to play, click on “START” button and wait for the beep sound. While playing, users can see the real-time results on the screen. Users can save the score by clicking on “SUBMIT” button and can deduct score when they miss a target.

On add stage tab, users can create stages by finding online targets then configure them on each target, add image that describe the stage, add description. For each target, user can set description and delay.

4. Results

In the experiment, we simulate the stage as IPSC competition for training. This experiment is about adding stage, setting up, playing and submitting score.

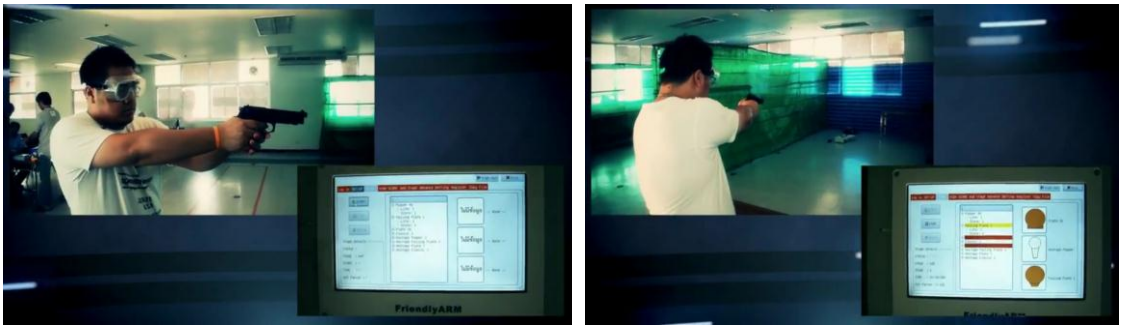

Fig. 3. Shooting experiment

5. Summary

IPSC Training System can be used in real competition and training for developing shooting skills in general public, and in police and soldier trainings to increase their performances in real life situations. Targets in the system can be adapted to get hit with bullets from real gun and, also, the system can adapt to several targets because it has threshold for difference target. Circuit sensors for shooting detection in the system have an interval 250 ms for shooting the next shot. This system can be further developed for more useful functions in the future.

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