# Application Note: AZD074
# How to design a $3.50* educational touch toy
## IQ Switch®- ProxSense® Series

## 1 Introduction

Capacitive touch keys provide robustness and flexibility to a cost-effective educational toy. Touch keys will withstand the 'abuse' inflicted by children when they play. This guide on "How to design a $3.50 educational touch toy" describes the design and execution of an educational touch toy with the constraint of a $3.50 BOM cost. The toy will respond with a variety of audio clips, depending on the icon touched by the child.

## 2 Proposed solution

The IQS550, coupled with a voice integrated ic, will provide the solution to making a low-cost educational toy. The proposed solution will integrate Azoteq's IQS550 touch controller with the Aplus aMTP32M voice integrated ic. With this particular voice integrated ic, a maximum of 255 sound enabled touch keys are possible.

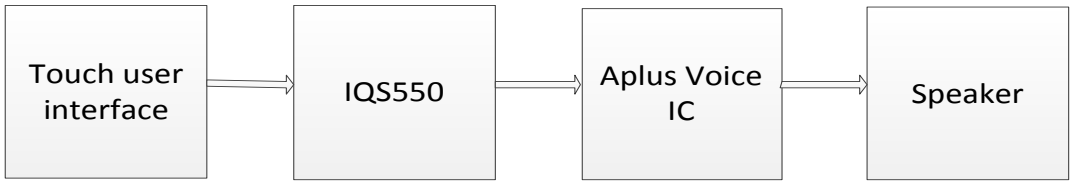



**Figure 2.1 System block diagram**

## 3 Design specification

*The specifications for the educational toy are the following:

- Complete BOM cost of $3.50
- Minimum of 80 buttons
- Integrated sound
- Touch keys
- 7" Tablet-type form factor

To comply with the $3.50 BOM specification cost the following components were selected:

1. Azoteq IQS550 touch sensor
   - Cost effective
   - Sufficient number of touch keys
   - Low power consumption
2. Aplus aMTP32M voice ic
   - 660s integrated voice time
   - 256 voice addresses
3. Speaker
4. Single sided FR1 pc-board
   - Cost effective for large-sized form factor
   - 7” tablet form factor
5. Miscellaneous
6. Plastic (or other) Mold
7. Graphic inserts

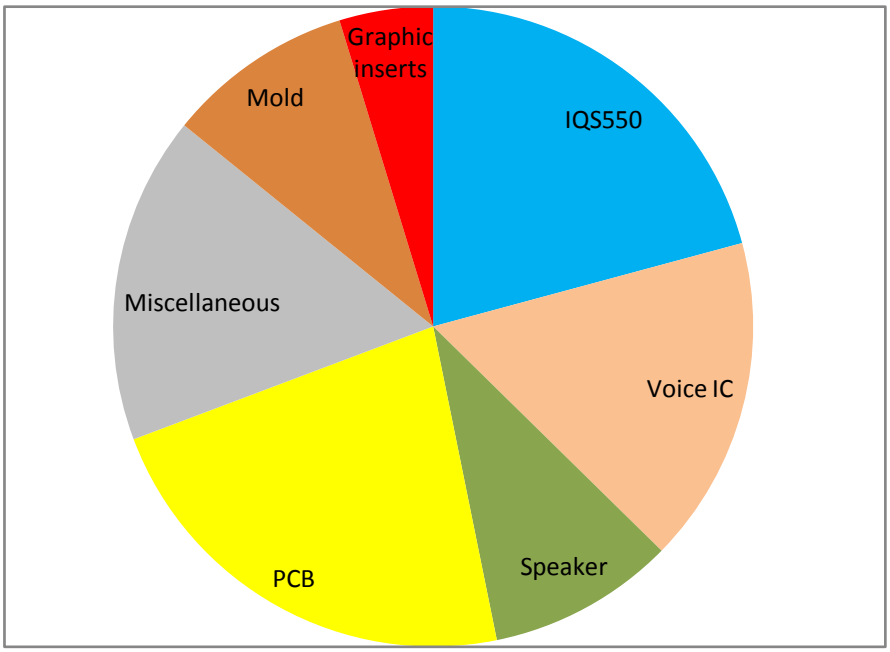



**Figure 3.1 Pie chart of BOM cost**

Due to the cost of pc-boards, a novel idea had to be found for a design with 160 touch keys. The touch keys had to be big enough for activation by a toddler. The keys had to be spaced far enough apart so that no two keys could be pressed simultaneously.

For eight games to be played with the same HW platform, eight graphic inserts are used. Each insert has a different theme. The different inserts are detected with a capacitive method from the source touch ic. The voice ic responds with the appropriate sound for the particular graphic of the particular insert. The hardware supports 20 keys. With eight graphic inserts, it therefore allows for 160 independent graphics each with a unique sound.

The pc-board for the design is shown Figure 3.2. Figure 3.3 shows a typical graphic insert.

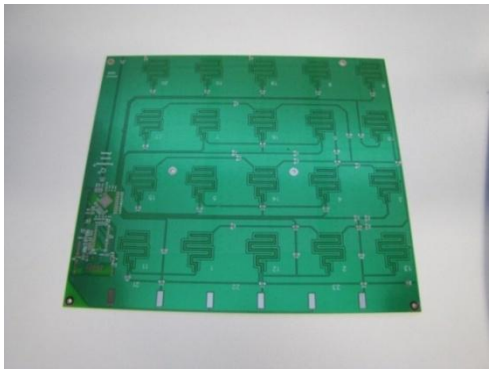


**Figure 3.2 Pc-board for educational toy**

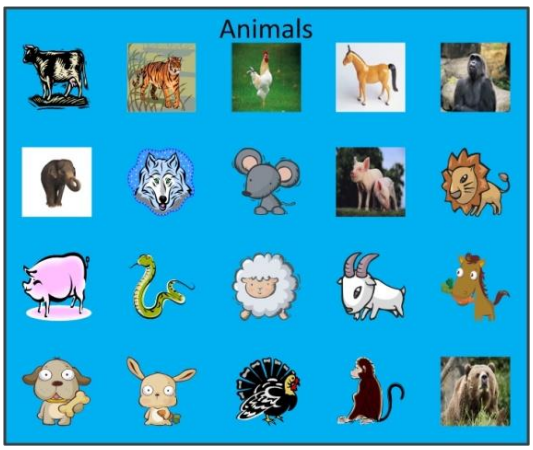



**Figure 3.3 Typical graphic insert**

The graphic select sensors are placed on the edge of the pc-board, as in Figure 3.4. These sensor keys are used to differentiate between the eight different graphic inserts. Each insert is coded with a different binary code. This code is in the form of a conductive strip, as in Figure 3.5, which is sensed by the main board's hardware.

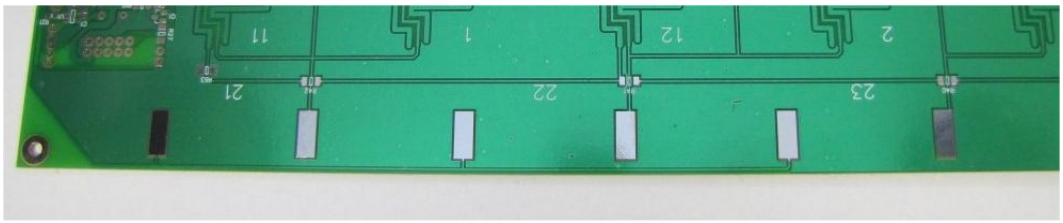



**Figure 3.4 Graphic select sensor**

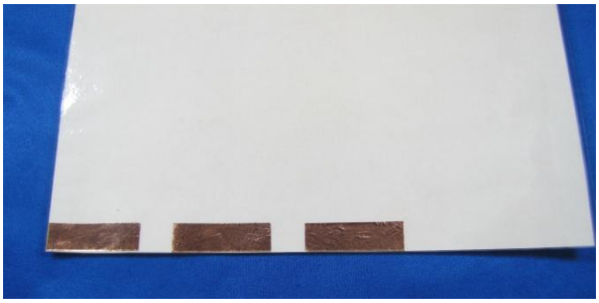


**Figure 3.5 Conductive strips on the graphic insert identify each unique insert.**

The graphic option senor is a three bit binary number.

# 4 Design considerations

- The hardware must be rigid
- Touch keys must be spaced so that they will not be pressed simultaneously
- Graphic selection sensors must be placed on the edge of the pc-board
- Mounting holes should be placed on the edges of the pc-board
- Keys should not be placed near the edge, to avoid accidental activation when holding
- The normal IQS550 interface is $I^2C$. Custom code is needed for communication with the Aplus voice ic, as it uses a propriety communication interface.
- The total capacity of the voice ic should be sufficient to store enough sound clips.

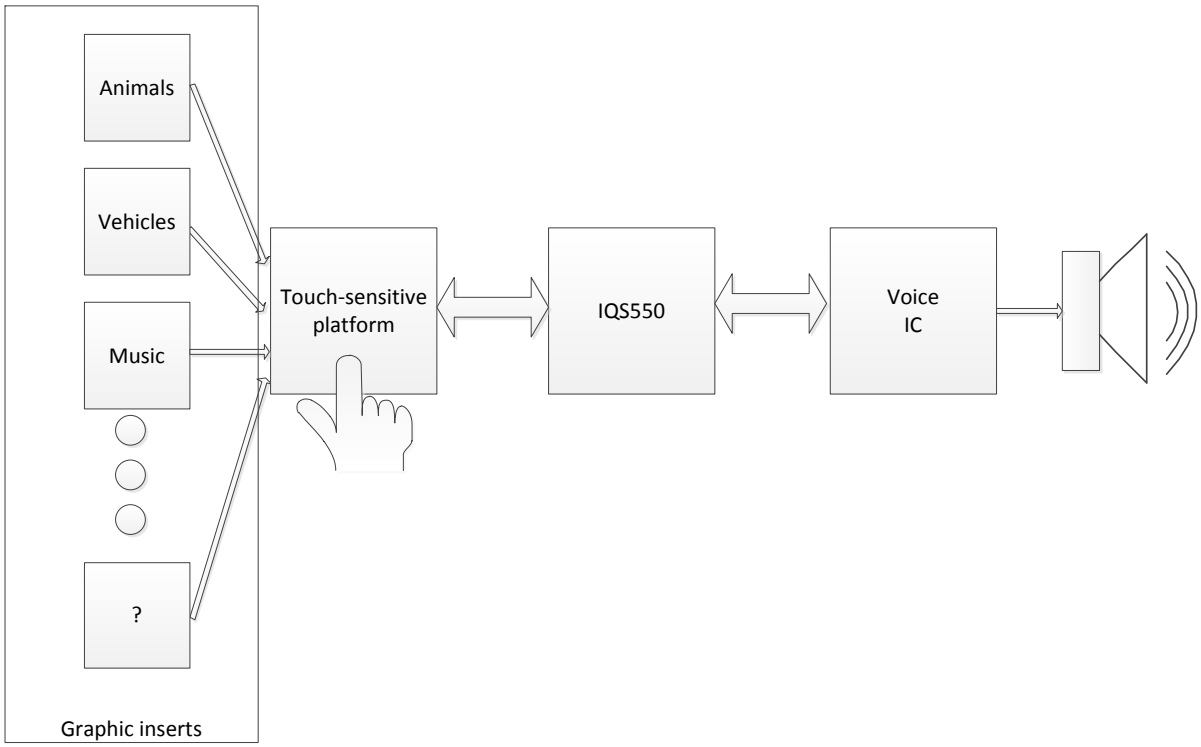



**Figure 4.1 System block diagram**

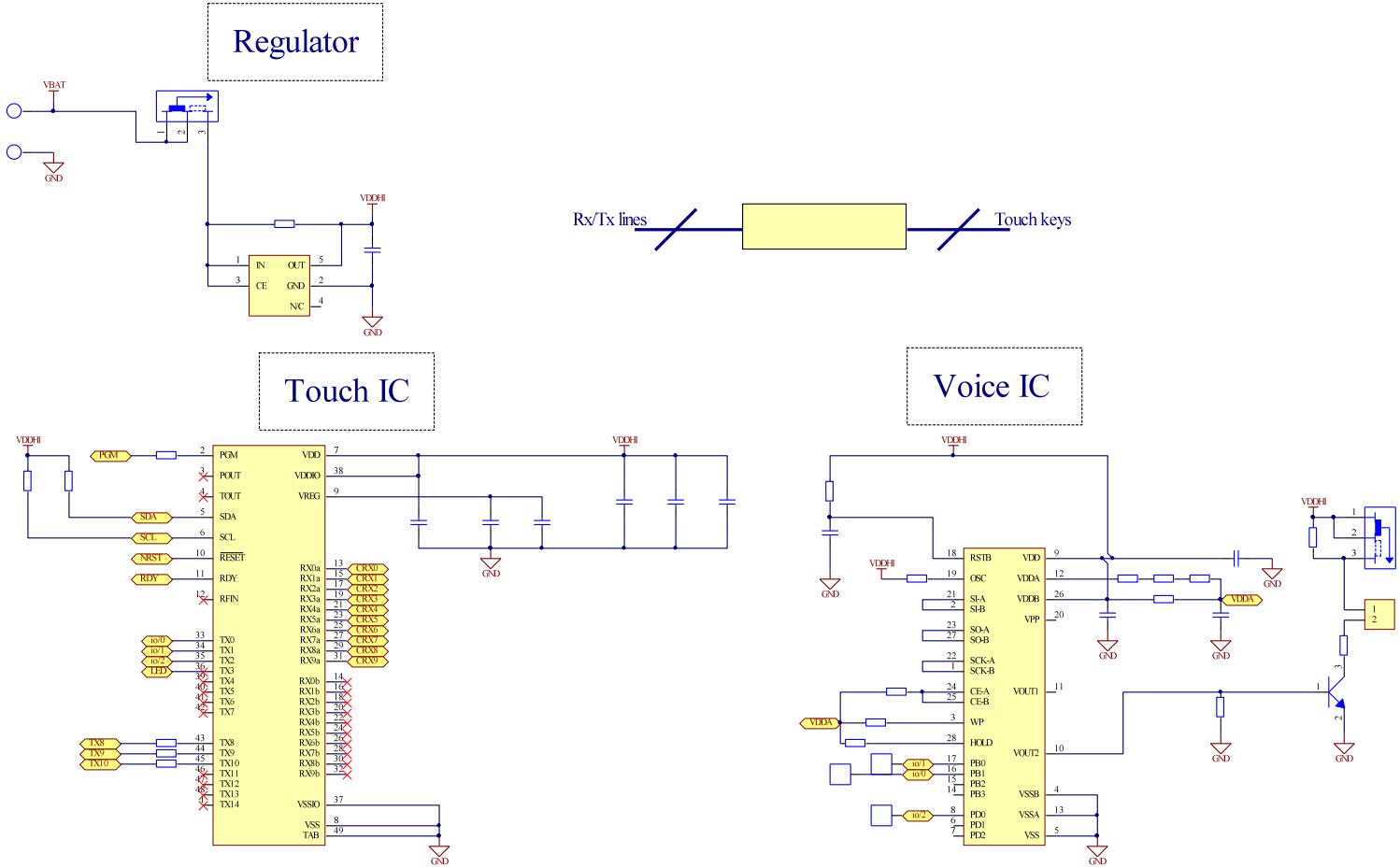



**Figure 4.2 Educational toy schematic**

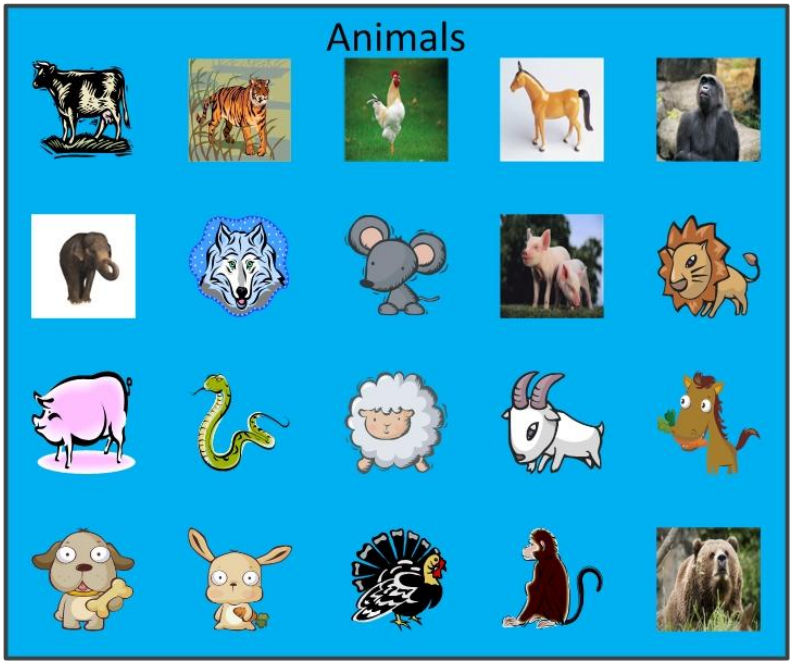
# 5 Further Ideas

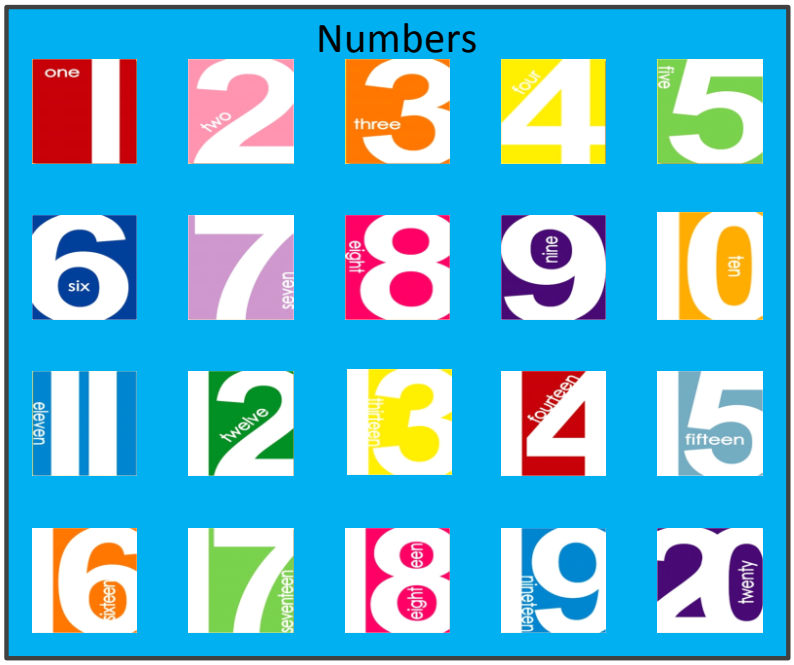
- Drum kit
- Electric touch guitar
- Turn table
- Touch toy smart phone
- Smart music carpet
- Music keyboard/ touch piano
- Musical books
- Interactive advertisements
- Toy cars
- Toy figurines
- Price tags
- “Blindman’s” watch

# 6 Design resources

- www.azoteq.com
- http://www.aplusinc.com.tw/
- IQS550 datasheet
- CT-210
- aMTP32M datasheet
- AZP431A01 gerbers

# 7 Graphical Inserts



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