LOW COST WAVE AND WAKE FEATURE FOR PRINTERS

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Recommended Citation
INC, HP, "LOW COST WAVE AND WAKE FEATURE FOR PRINTERS", Technical Disclosure Commons, (November 17, 2020)
https://www.tdcommons.org/dpubs_series/3774

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**Low cost wave and wake feature for printers**

Low cost wave and wake feature for printers is a method to introduce a new contactless wave/approach and wake feature at almost no cost, through the use of a spare pin of existing Control Panel(CP) Programmable system-on-chip(PSOC) and a simple wire loop.

Previous methods of detecting people approaching the printer, involves Infrared based time of flight or proximity sensor; these solutions are expensive, with solution cost range from $1.20 to $3.50 PER SENSING DIRECTION.

This paper proposed a solution that allows a printing device to do contactless proximity sensing at almost no cost, through the use of a spare pin of existing control panel PSOC and a simple wire loop.

**Construction of solution**

This solution consists of

1) Unused Control Panel PSOC pins
   a. linked to the PSOC internal CapSense Sigma-Delta (CSD) block via Firmware(FW)
   b. setting the pins in self capacitance sensing mode to drive the wire loop-based proximity sensor
2) A simple low-cost wire to create a wire loop-based proximity sensor
3) Additional mechanical wire clips that were designed to part of the existing bezel and casing etc.

Wire loop-based proximity sensor is used, as it allows us to have the flexibility of
1) placing the sensor(s) anywhere in the printer
2) and at multiple locations

![Figure 2: Example of a target position to place the wire loop-based proximity sensor](image)

Below are the few target positions to place the wire loop-based proximity sensors

1) Below the control panel bezel:
   a. This location allows the user to wake up the control panel back light, by just waving over it or touching any edge of the control panel
   a. Please refer to attached demos videos “Hand_touch_side.mp4” and “Hand_Hovering~7cm.mp4” zipped in attachments
2) Just below the side or front casing of the printer:
   a. This allows the printer to wake up the control panel back light when the user is at a distance of 300mm or less from the printer
   b. The larger surface area of these locations allows longer wire loop proximity sensor to be formed
   c. Which greatly increase the proximity sensing distance up to 300mm, depending on the size of the printer
3) It just takes 3 wires + 3 spare PSoC pins to achieve an omni directional people approach sensor effect,
a. without the following cost and complexity of a typical proximity/TOF sensor
   i. cost of between $1.20 to $3.50 per sensing direction
   ii. complexity of 4 to 5 lines per sensor
      1. Vcc
      2. Gnd
      3. Sdata
      4. Sclk
      5. Interrupt

   ![Sample Self-Capacitance model from PSoC datasheet](image)

   Figure 3: Sample Self-Capacitance model from PSoC datasheet

How it works, refer to Figure 1 and 3

1) The PSoC pin is set to self-capacitance mode
   a. This allows us to use a single pin and measure the capacitance between the wire
      loop connected to that pin
   b. and remote ground indirectly by driving current on a pin connected to a sensor
      and measuring the voltage
   c. the human is grounded thus forming the other half of the capacitor plate
   d. when a person/hand is moved near the proximity sensor, it will increase the
      measured capacitance
   e. thus, allowing detection of the human or hand

2) The wire loop-based proximity sensor
   a. Could be made up of a copper tape or wire
      i. So, depending on the printer design either method could be used
   b. The shape could be a circle, rectangle etc
      i. So, depending on the printer design the design could be flexible to a
         certain extend
   c. it is basically using
      i. the human finger/body as a parallel capacitor plate
      ii. and the human body path to gnd as the capacitance path to gnd
      iii. the dielectric is the air or control panel overlay in between etc

3) Thus, allows detection nearby human/hand/objects without physical contact, as long as it
   have a virtual/remote path to ground to complete the loop
Disclosed by Yu Zhao, Samuel Low, HP Inc.