Prototyping Touchscreen Blaise Applications

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1. Introduction

The integration of new technology in survey research has led to new developments in computer-assisted interviewing applications. Touchscreen functionality can improve usability and, potentially, improve data quality and reduce interviewing costs by providing a more user-friendly, straightforward means of navigating through a data collection instrument. With several large-scale, in-person data collection screening studies on the horizon at the University of Michigan, and plans to purchase new hardware, we have explored existing touchscreen capabilities within Blaise 4.8. In this paper, we will describe the development of a touchscreen Blaise screening application prototype in consideration for two studies that will begin data collection in in 2015-2016. The developmental goal of this exploration is to design a touchscreen household screening application to be used by field interviewers to screen over 50,000 households in the next year. The prototype builds on the work done by Hofman and colleagues in 2013 and furthers the development of touchscreen applications in Blaise 4.8.

2. Background

Survey Research Operations (SRO), a unit within the University of Michigan's Institute for Social Research's Survey Research Center, has used Fujitsu Lifebook Convertible Tablet PCs for close to a decade. Between 2005 and 2010, the Fujitsu Lifebook T4220 utilized Windows XP Tablet PC Edition and was limited to a digital pen (or stylus) input while in tablet mode. The laptop pool was refreshed in 2010 with the Fujitsu Lifebook T730's which used Windows Enterprise 7 64 bit and had dual digitizers (digital pen input and multi-touch screens). In 2015, we began replacing the laptop pool again with Fujitsu Lifebook T734's. The T734 came with the option of having Windows 8.1 or 7 64 bit editions. The Survey Research Center has decided to forego upgrading to Windows 8 with the intention of moving to Windows 10 instead. Therefore, the T734's are loaded with Windows Enterprise 7 64 bit with dual digitizers. Despite having the digital pen input option available for ten years and gaining touchscreen ability five years ago, these features have only been used to a limited degree in a production environment. In fact, the touchscreen functionality was disabled in the production environment on the T730 pool of laptops (2010-2015).

Several proofs of concept were created and explored in an attempt to use a digital pen as a means of input. Examples include exploring the possibility of using Blaise Basil for ACASI instruments. The interest in Basil resulted from its ability to provide developers greater control of screen design. However, it was found to be significantly more difficult to program. Spaulding (2012) demonstrated the creation of a touchscreen ACASI instrument using Basil developed by the US Census Bureau for the National Health Interview Survey. The Blaise 4.8 Help file describes Basil as,

> "…an alternative data entry program for Blaise questionnaires, specifically designed to handle Self Interviewing situations. BASIL combines the strength of the Blaise rules engine with the flexibility of Maniplus, which allows programmers of BASIL to create tailor-made applications."

While SRO did not adopt Basil for ACASI instruments, an application was developed to capture respondent signatures during the informed consent process and to sign cash receipts using the stylus. This process was recently updated and expanded in Blaise (Gatward et. al. 2015).

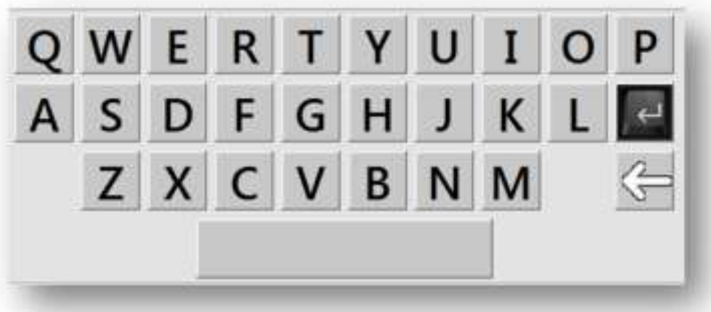
The limited use of the digital pen and touchscreen features to date is primarily due to the lack of features integrated within our core set of supported software products used to support the collection of survey data in the field until now.

3. From Keyboard & Mouse to Touch-Friendly Applications

The process of transitioning from traditional keyboard and mouse driven data entry to one that is touch-friendly can take many forms and involves understanding the core elements needed for one to complete a given task, or set of tasks, without the use of the traditional mouse or keyboard. If the task requires a keyboard entry, is the operating system's native touchscreen keyboard sufficient? If the native keyboard does not work, then one must build their own keyboard. Finally, the traditional menu driven process within software applications was not created with touch input in mind. Therefore, this transitional process needs to take into account larger elements allowing for finger input, as is done via a keyboard.

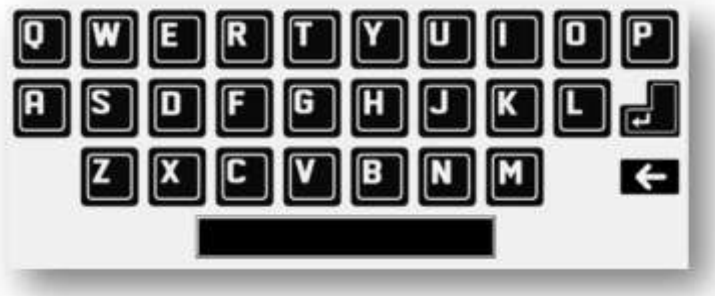
Our prototype took a transitional process that built on successive approximations and the starting point was a sample menu provided by Statistics Netherlands, used in the Caribbean Netherlands Implementation (Hofman et. al. 2013), and progressed through fluid iterative processes of exploring what was possible. A key requirement was the ability to enter text into the application at the point where we capture individual's names within a household listing while screening for eligible respondents. We created many keyboards and the final proof of concept implemented was to emulate the look and feel of a more familiar mobile keyboard within the Blaise Menu file. This led to building an elaborate keyboard using the Blaise Menu file. Building a new keyboard required several iterations in order to understand the placement of elements. An early version of the keyboard prototype is presented in figure 1. Although, this version would allow one to enter an individual's name on text fields in an instrument, this standard keyboard was not ideal because of the rudimentary nature of the keyboard.

Figure 1: Example Keyboard in a Blaise 4.8 Menu File



We then began to look for available images that would provide a cleaner presentation that appeared more like a real keyboard. One version had black keys with matte letters, as shown in figure 2. This keyboard is completely functional and gives the feel of a more authentic keyboard presentation. Nevertheless, we felt we could do better.

Figure 2: Keyboard in a Blaise 4.8 Menu File using Images of Black Keys



Despite the availability of these two keyboards, we wanted to attempt to emulate a keyboard design that was cleaner and decided to attempt to replicate a design more widely used on mobile platforms in the Blaise Menu file. A screenshot of the mobile platform keyboard is shown in figure 3 and figure 4 shows the Blaise menu file attempt to emulate it.

Figure 3: Mobile Keyboard

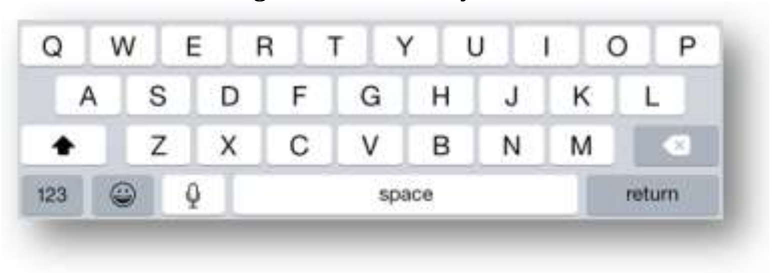
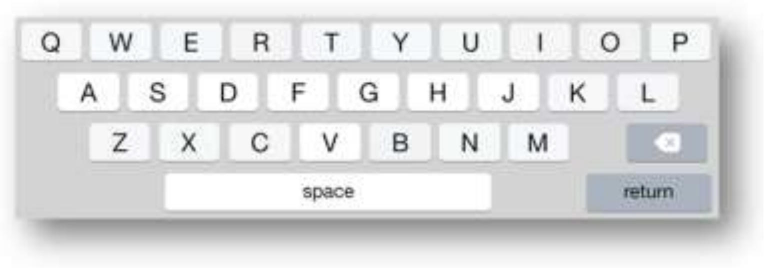


Figure 4: Blaise Menu File Emulating a Mobile Keyboard



The cleaner keyboard images, as displayed in figures 3 and 4, sparked enthusiasm in the Blaise programmer in the potential options that could be realized in developing a new on-screen keyboard. However, keyboard images readily available had limitations. Not all of the keys were always present and the simple, clean look that we were looking for was not always available. Therefore, it was at this point that we realized that we would need to begin to create the desired keys and keyboard from scratch. Developing a new keyboard would involve creating keyboards in a graphical creation software program such as Adobe Photoshop. We used the diagraming and vector graphics applications within Microsoft Office Visio. We used Visio to build the raw keyboards and then increased the presentation of the keyboards to 400% to take accurate screen captures, key by key. The larger screen captures were later scaled into the appropriate pixel width and height for the given item within the Blaise menu file. For example, the button pixel dimension determined for the main menu panel were 56 by 56 pixels and the typical keyboard keys were scaled to the pixel width and height of 70 by 45.

Ultimately, this process of building the keys and buttons from scratch provided the desired method to produce a screen presentation that was simple and clean. However, it is likely not the quickest method. A graphics designer rendering a series of key images in advance could enhance the process of designing a keyboard.

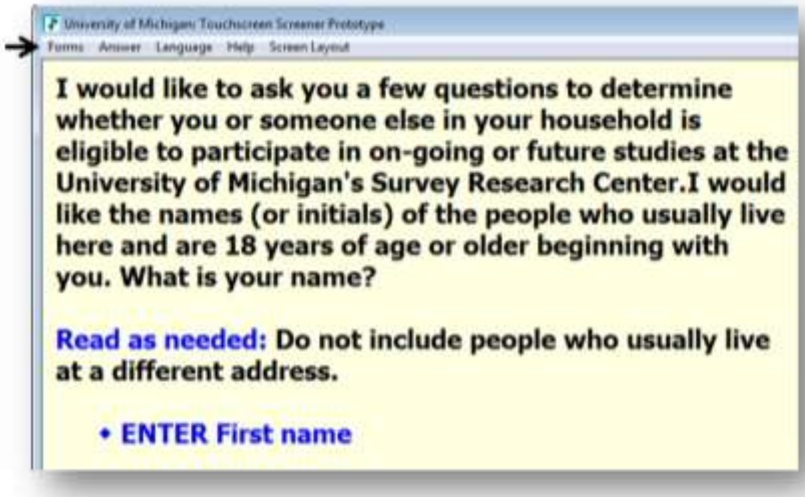
4. Blaise Touchscreen Implementation Essentials

Once we began to explore the capabilities added to the Blaise Menu file, it became clear that a potential solution could exist for our first production touchscreen application. Specifically, Blaise 4.8 added the capability of enhancing the menu file, by replacing the button bar concept with a panel concept (Blaise 4.8 Online Help, 2015). This was done to allow for greater flexibility in Blaise IS. However, these features were also exposed within the Data Entry Program. In this section, we discuss three Blaise elements essential to this touchscreen prototype: the menu file, the mode library settings, and menu data storage.

4.1 Menu File

Blaise 4.8 introduced a “panel concept” within the Menu file offering one the ability to create a completely different means of presenting the traditional menu options on the button bar. For the UM Blaise 4.8 touchscreen prototype, the majority of the work was completed in the Menu file within the Blaise Menu Editor. The traditional Blaise menu presentation is shown in figure 5:

Figure 5: Traditional Blaise Menu File



I would like to ask you a few questions to determine whether you or someone else in your household is eligible to participate in on-going or future studies at the University of Michigan's Survey Research Center.I would like the names (or initials) of the people who usually live here and are 18 years of age or older beginning with you. What is your name?

Read as needed: Do not include people who usually live at a different address.

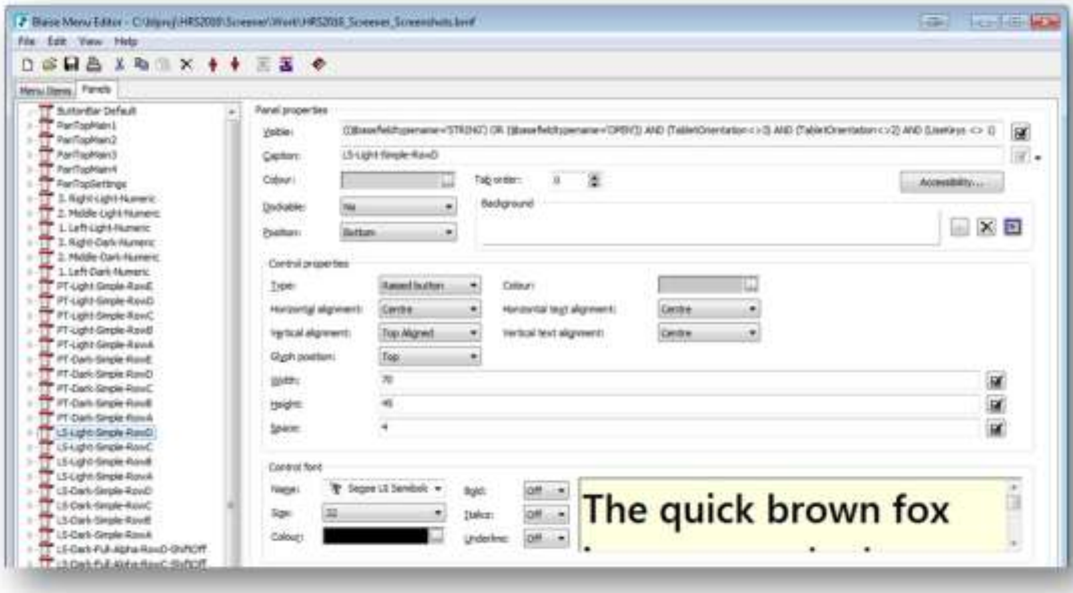
• ENTER First name

The key elements of the menu file, in our opinion, are the panels and their controls (child elements of panels), visibility expressions, and control actions. The uses of these elements as they relate to the touchscreen prototype are discussed further.

4.1.1 Panels and Controls

Panels are the parent and controls are the child of a panel. Attributes defined in the panel can be inherited or overwritten in the control. For example, the panel is typically a set of items presented in one row or column and the controls are the items that are in the panels. Figure 6 shows the bottom row of a simple keyboard designed for landscape presentation. Figure 7 shows all of the controls within this panel.

Figure 6: Example Panel in the Prototype



Panel properties

Visible: ((@basefieldtypename='STRING') OR (@basefieldtypename='OPEN')) AND (TabletOrientation<>3) AND (TabletOrientation<>2) AND (UseKeys <> 1)

Caption: LS-Light-Simple-RowD

Colour:

Tab order: 0

Dockable: No

Position: Bottom

Control properties

Type: Raised button

Colour:

Horizontal alignment: Centre

Horizontal text alignment: Centre

Vertical alignment: Top Aligned

Vertical text alignment: Centre

Glyph position: Top

Width: 70

Height: 45

Space: 4

Control font

Name: Segoe UI Symbol

Bold: Off

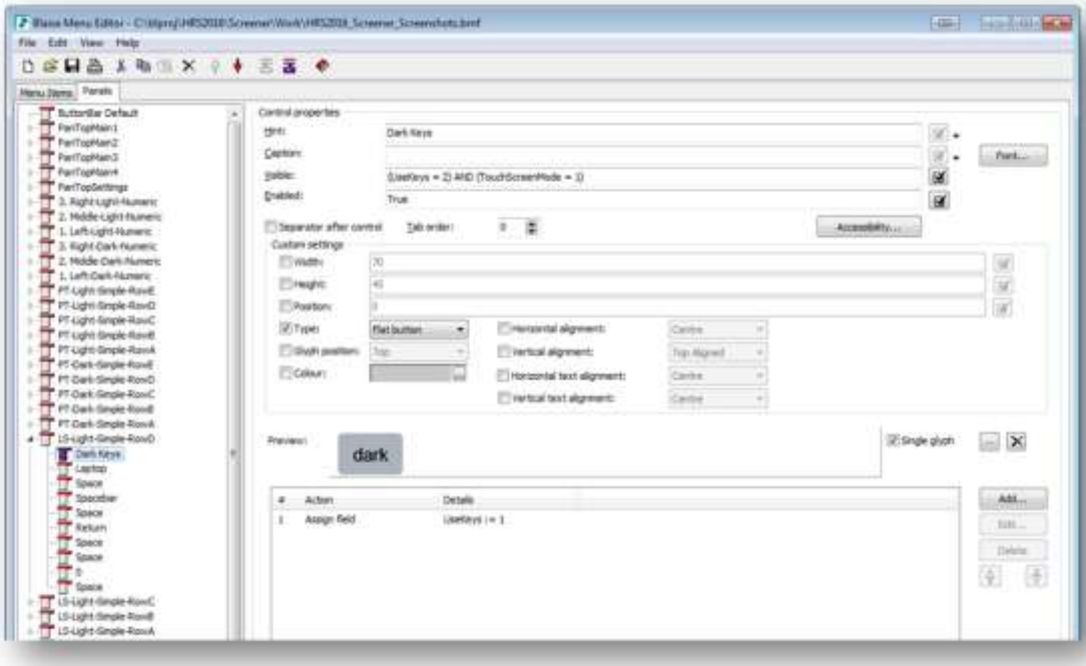
Size: 22

Italics: Off

Colour:

Underline: Off

Figure 7: Example Control in the Prototype



Control properties

Hint: Dark Keys

Caption:

Visible: (UseKeys = 2) AND (TouchScreenMode = 1)

Enabled: True

☐ Separator after control Tab order: 0

Custom settings

☐ Width: 70

☐ Height: 45

☐ Position: 0

☑ Type: Flat button

☐ Glyph position: Top

☐ Colour:

☐ Horizontal alignment: Centre

☐ Vertical alignment: Top Aligned

☐ Horizontal text alignment: Centre

☐ Vertical text alignment: Centre

☑ Single glyph

#	Action	Details
1	Assign field	UseKeys := 1

Each row or column of a given element in a touchscreen prototype is represented as a panel on the left. Therefore, if an alphanumeric keyboard consists of four rows, there are four panels for the keyboard in the Menu file. Previously, in section 3, we discussed the methods we used to conceptualize and construct the keyboards into the menu file.

4.1.2 Visibility Expressions

Using expressions within visibility conditions of panels and controls is powerful. This allowed for great flexibility when building the touchscreen prototype. Expressions allowed us to build one menu file containing many different keyboard presentations. For example, if a question had "don't know" or "refused" attributes we could use expressions to display the "don't know" or "refused" buttons. Otherwise, those buttons are not displayed for a given question. We also used data stored within the data model to assist in driving the presentation of items on the screen; this is discussed further in section 4.3 Menu Data Storage.

It is important to understand if one expression fails within menu files it has a cascading effect that will prevent many of the menu panels from displaying properly. Therefore, it is important to meticulously test expression usage within menu panels and controls.

4.1.3 Control Actions

Control actions are the assignments attached to a given control. For example, the "A" key has a 'keyboard action' of the key value of [A]. During our review, we attempted to replicate all actions of a full keyboard and were able to map everything with the exception of a double quote key. Other items we could not map were the Euro "€", Pound "£", and Yen "¥" signs. However, this could have been because our U.S. based keyboard did not have the options for these keys. Control actions are important, as they become the actions and assignments behind the scenes that drive the touchscreen presentation and navigation through the instrument.

4.2 Mode Library Extensions

Two new layout sets were added to the mode library file and the normal laptop CAPI layout set was retained as well. The two additional layout sets added were for portrait & landscape touchscreen presentation on the tablet. The laptop set allows us to flip back to our traditional CAPI presentation. The portrait layout set maximizes the tall and narrow screen presentation. The landscape layout set uses the width of the screen to maximize the placement of the various elements.

Other mode library changes were to increase the default font to 16-pt. and make it bold. Within the portrait and landscape layout sets, we changed the answer list button sizes to 13 and changed all of the backgrounds of the InfoPanes to white. A white background provides better contrast which is important in outdoor or daylight settings, as will be the case when screening households using a touchscreen application in the field.

4.3 Menu Data Storage

While creating the prototype, we needed a means of storing current settings and other actions associated with menu options and the control assignments to dynamically alter the menu presentation. In Blaise, this can be done using registry settings and environment variables in Windows. However, given the rapid turnaround of the prototyping process we created a series of constructed variables in the data model that were always on route and had .KEEP assignments, allowing for successive iterations where we could easily build data values from these variables into the visibility conditions. Figure 8 shows a table of the constructed variable we built into the data model to aid in driving the dynamic presentation of the menu panels. Many of these variables were added to aid in the demonstration of the prototype and are likely not needed in a production setting.

Figure 8: Constructed Variables Used in the Prototype

Constructed Variable	Description	Values (Default = bold)
UseTouchscreenMenu	Determines if the touchscreen menu can be used or not	**1 = Yes** 5 = No
AllowMods	Determines if a user can make changes to the current touchscreen settings	**1 = Yes** 5 = No
TabletOrientation	Tablet screen orientation	**1 = Landscape** 2 = Portrait 3 = Laptop Mode
TabletMode	Tablet Mode	1 = Laptop **2 = Tablet**
UseKeys	Which Keys to use	1 = Dark Keys **2 = Light Keys**
Keyboards	Which Keyboard is selected	**1 = Basic/Simple** 2 = Full: Mobile Alpha 3 = Full: Mobile Numeric 4 = Full: Mobile Symbol 5 = Full: Win7 OSK Alphanumeric
OS_KeyStyles	Which style should be used	**1 = Mobile** 2 = Win7
L10N_Keyboards	Use a localized version of the keyboard, US Qwerty only option	**1 = US Qwerty** *2 = UK* *3 = Chinese* *4 = Nepali*
LangSelected	If more than one language is used, which language has been selected	**1 = English** 2 = Spanish
TouchScreenMode	Determines how and what is presented to the end user at run time	**1 = Demo** 2 = Testing 5 = Production
ChangeSettings	Opens the settings touchscreen toolbar	1 = Show settings touchscreen bar **5 = Touchscreen Settings off**
ExitSettings	Use to exit the settings touchscreen toolbar	**Empty** 1 = Yes
AllowCAPI	Determines if the normal CAPI mode is an available option	**1 = Yes** 5 = No
ShiftState	If the shift button has been selected or not	**1 = Inactive** 2 = Active
CapsLockState	If the cap locks button has been selected or not	**1 = Inactive** 2 = Active

5. UM Touchscreen Prototype

The UM touchscreen prototype is made up of a touchscreen toolbar, alphanumeric keyboards and numeric keypads depending on the underlying question type. Other elements on the screen have been made larger for a touch-friendly user experience.

5.1 Touchscreen Toolbar

The touchscreen toolbar replaces the traditional Blaise menu (seen previously in figure 5). It is made up of four menu panels where images change to give the illusion that one panel is being used. This can be accomplished by using one panel and defining the fixed pixel location of elements and their associated images. However, the multiple panel method was chosen for its ease of scaling across multiple tablets that have different pixel density because of different screen resolutions and sizes. The location of two buttons changes between four images in the four panels. The first button location that changes is the landscape and portrait options which allow the user to switch between the landscape and portrait layout sets depending on the current tablet orientation. The second button location is the language selection button where one can switch between English and Spanish languages in the prototype. Figure 9 provides a matrix of the touchscreen toolbars and how the visibility conditional on the panels and controls interact with associated actions and assignments of these four panels to give a single unified appearance.

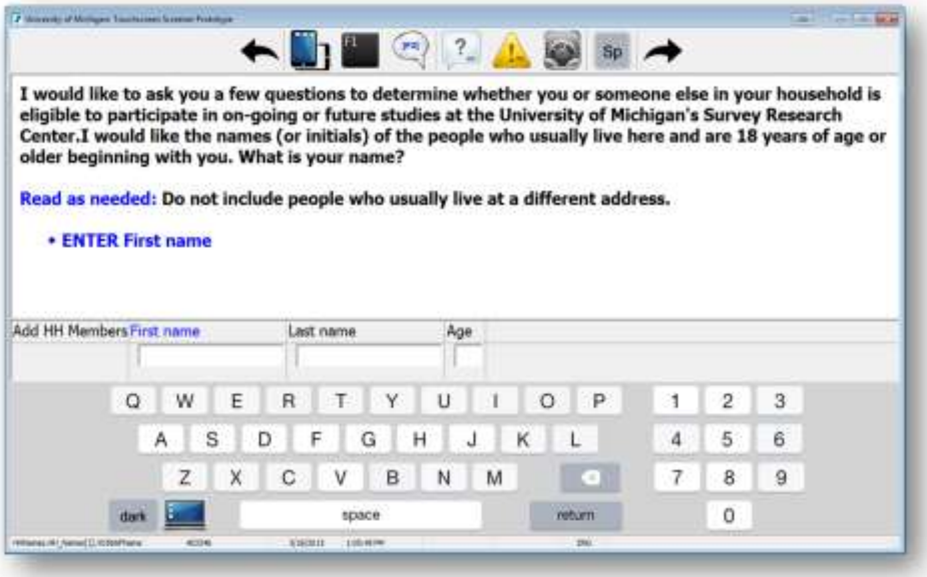
Figure 9: Touchscreen Toolbar Visibility, Action, and Assignment Matrix

	Panel					
	PanTop-Main1	**PanTop-Main2**	**PanTop-Main3**	**PanTop-Main4**		
	Visibility Conditions: TabletMode=2 AND ChangeSettings <> 1					
	TabletOrientation<>2		TabletOrientation=2			
	LangSelected = 2	LangSelected = 1	LangSelected = 2	LangSelected = 1		
Image	**Control**				**Action & Assignment**	**Visibility Condition**
↩	Previous				Pervious Field	True
▯	Portrait		▨	▨	**Assign field** TabletOrientation := 2 TabletMode := 2 **Set layout set** = Portrait	Determined in the panel
▭	▨	▨	Landscape		**Assign field** TabletOrientation := 1 TabletMode := 2 **Set layout set** = Landscape	Determined in the panel
F1	F1				Question Help	($LOCALFIELDTAG='Help')
[F2]	F2				Make Remark	True
? DK	Don't Know				Don't Know	position('D',$ATTRIBUTES)>0
! RF	Refusal				Refuse	position('R',$ATTRIBUTES)>0
⚙	Settings				**Assign field** ChangeSettings = 1	AllowMods = 1
En	English	▨	English	▨	**Assign field** LangSelected := 1 Set Language = ENG	Determined in the panel
Sp	▨	Spanish	▨	Spanish	**Assign field** LangSelected:= 2 Set Language = SPA	Determined in the panel
↪	Next				Next Field	True

5.2 Alphanumeric Keyboards and Numeric Keypads

The current prototype consists of a series of alphanumeric keyboards and numeric keypads to demonstrate potential features that could be leveraged in a touchscreen application. Additionally, we felt it was necessary for the interviewer to be able to dynamically switch between light and dark keys. The primary concern here was due to unknown external lighting factors associated with screening both indoors and out, as well as the influence of weather conditions. The main, 'simple', keyboards were created as a proof of concept. Figures 10a and 10b show examples of the simple keyboard with light keys and figures 11a and 11b show a similar keyboard presented with dark keys.

Figure 10a: Text Entry w/Light Keys (Landscape Presentation)



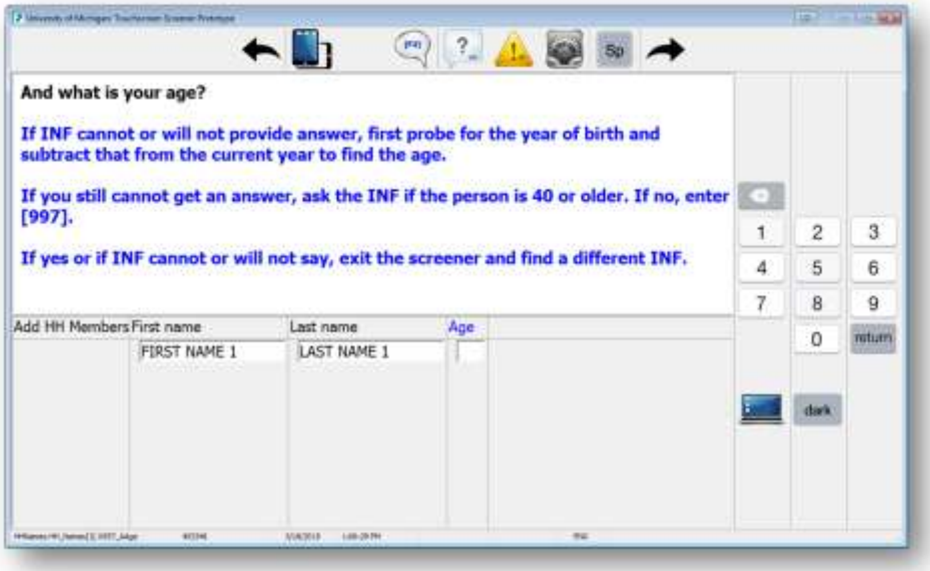
I would like to ask you a few questions to determine whether you or someone else in your household is eligible to participate in on-going or future studies at the University of Michigan's Survey Research Center.I would like the names (or initials) of the people who usually live here and are 18 years of age or older beginning with you. What is your name?

Read as needed: Do not include people who usually live at a different address.

• ENTER First name

Add HH Members First name Last name Age

Figure 10b: Numeric Entry w/Light Keys (Landscape Presentation)



And what is your age?

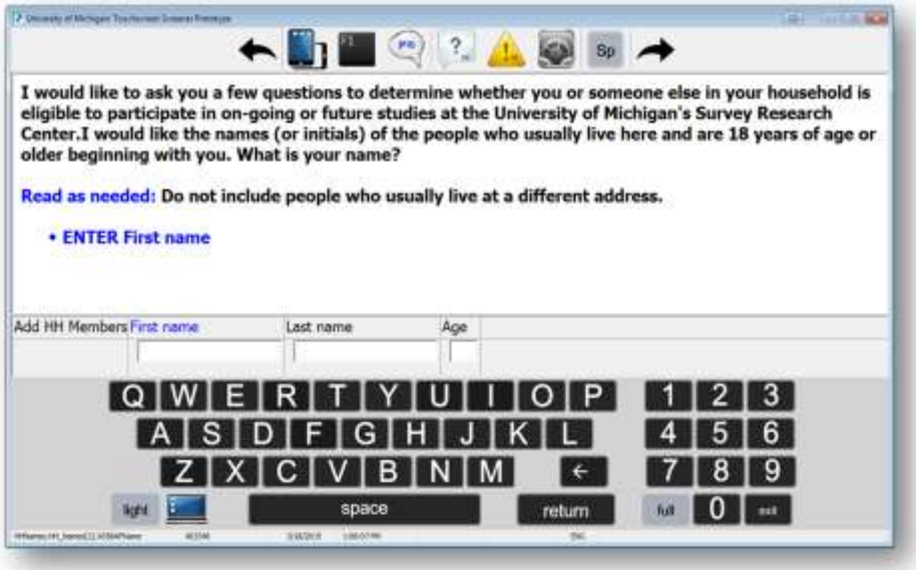
If INF cannot or will not provide answer, first probe for the year of birth and subtract that from the current year to find the age.

If you still cannot get an answer, ask the INF if the person is 40 or older. If no, enter [997].

If yes or if INF cannot or will not say, exit the screener and find a different INF.

Add HH Members First name: FIRST NAME 1 Last name: LAST NAME 1 Age

Figure 11a: Text Entry w/Dark Keys (Landscape Presentation)

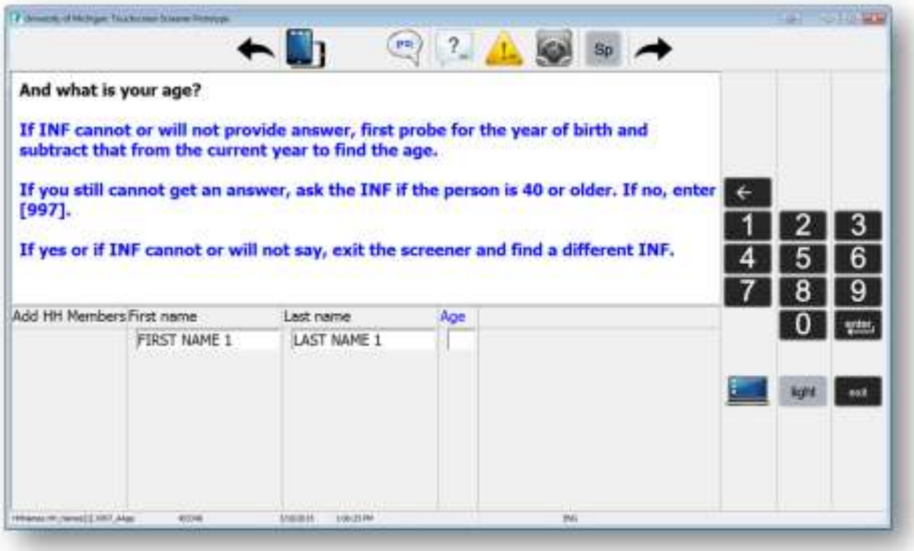

I would like to ask you a few questions to determine whether you or someone else in your household is eligible to participate in on-going or future studies at the University of Michigan's Survey Research Center.I would like the names (or initials) of the people who usually live here and are 18 years of age or older beginning with you. What is your name?

Read as needed: Do not include people who usually live at a different address.

• ENTER First name

Add HH Members	First name	Last name	Age

Figure 11b: Numeric Entry w/Dark Keys (Landscape Presentation)


And what is your age?

If INF cannot or will not provide answer, first probe for the year of birth and subtract that from the current year to find the age.

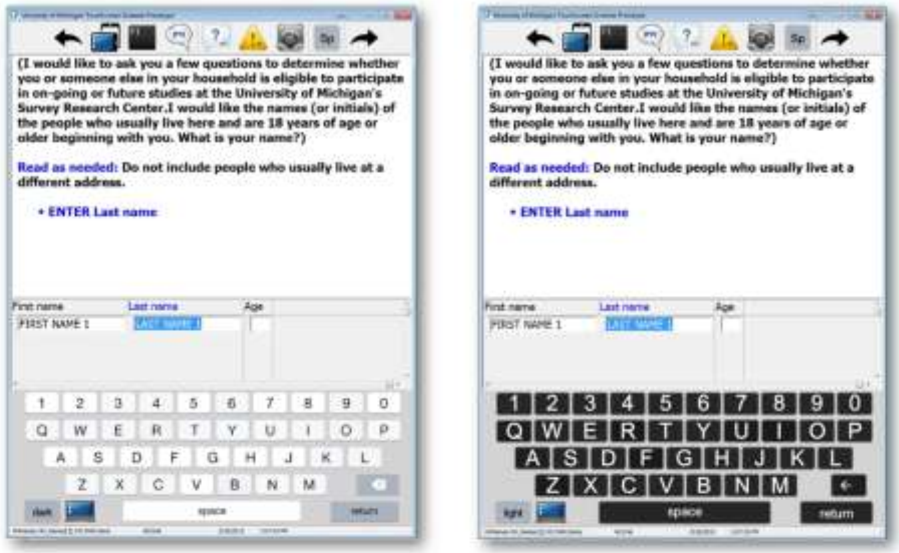
If you still cannot get an answer, ask the INF if the person is 40 or older. If no, enter [997].

If yes or if INF cannot or will not say, exit the screener and find a different INF.

Add HH Members	First name	Last name	Age
	FIRST NAME 1	LAST NAME 1	

In addition to offering keyboards for text keypads for numeric while in the landscape orientation we also added a different keyboard for text entry where the numbers moved on top of the keys. Figure 12 show how this would look if one were viewing the tablet in portrait orientation.

Figure 12: Text Entry in Portrait Orientation



(I would like to ask you a few questions to determine whether you or someone else in your household is eligible to participate in on-going or future studies at the University of Michigan's Survey Research Center.I would like the names (or initials) of the people who usually live here and are 18 years of age or older beginning with you. What is your name?)

Read as needed: Do not include people who usually live at a different address.

• ENTER Last name

First name	Last name	Age
FIRST NAME 1	LAST NAME 1	

The UM Touchscreen Prototype was expanded to explore whether a full keyboard, including punctuation and arrow keys, was possible. Two models were created to evaluate if a full keyboard could be created with the available custom keyboard actions with the actions associated with the available keyboard actions in Blaise. The two models for these different keyboards were created using dark keys to mimic the Windows Tablet Input Panel (figures 13a and 13b) and style presented in a mobile keyboard (figure 14a, 14b, and 14c).

Figure 13a: Windows OSK Style Full Keyboard w/Shift Inactive

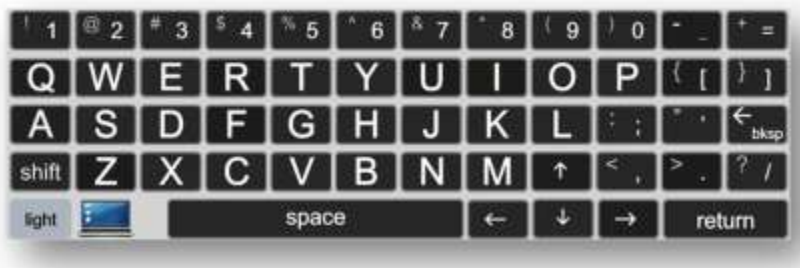

! 1 @ 2 # 3 $ 4 % 5 ^ 6 & 7 * 8 (9) 0 - _ + =
Q W E R T Y U I O P { [}]
A S D F G H J K L : ; " ' bksp
shift Z X C V B N M ↑ < , > . ? /
light
space
← ↓ →
return

Figure 13a: Windows OSK Style Full Keyboard w/Shift Active

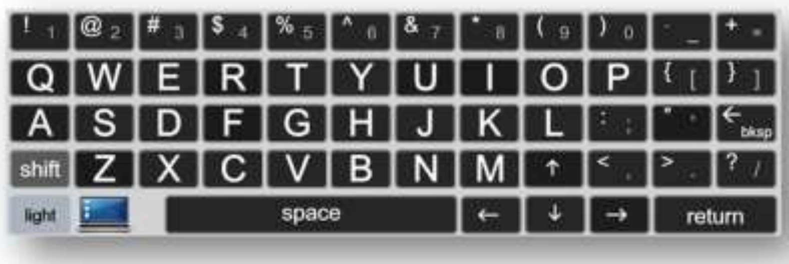

! 1 @ 2 # 3 $ 4 % 5 ^ 6 & 7 * 8 (9) 0 - _ + =
Q W E R T Y U I O P { [}]
A S D F G H J K L : ; " ' bksp
shift Z X C V B N M ↑ < , > . ? /
light
space
← ↓ →
return

Figure 14a: Mobile Style Full Alpha Keyboard (w/Shift Active)

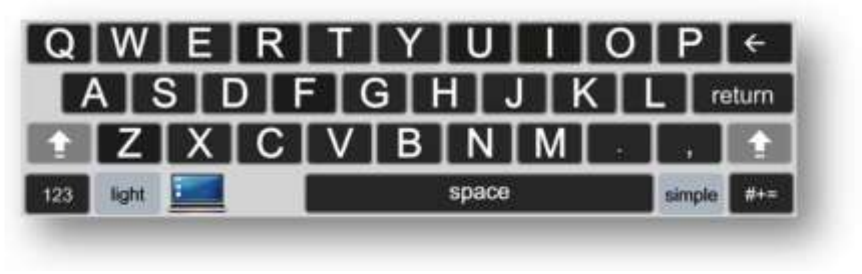


Figure 14b: Mobile Style Full Numeric Keyboard

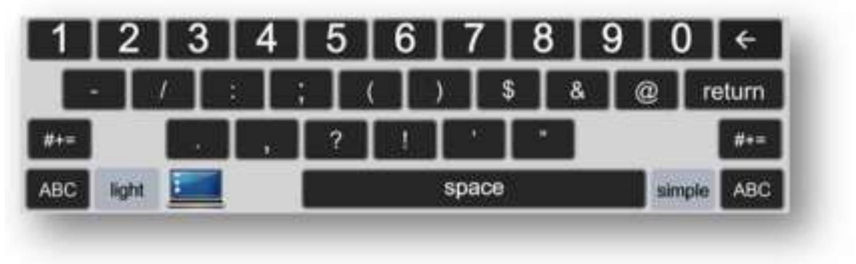
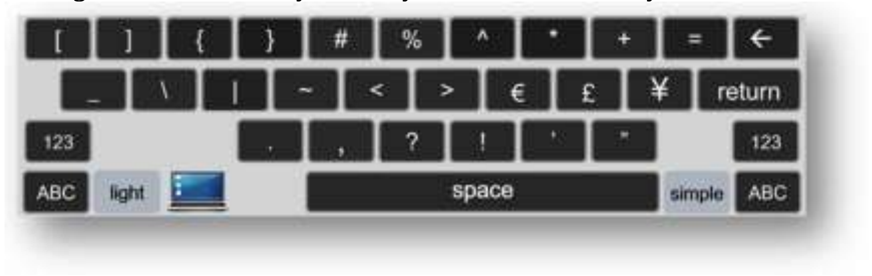


Figure 14c: Mobile Style Full Symbol Characters Keyboard



6. Future Exploration

Our preliminary findings suggest that Blaise 4.8 can leverage many of the desired touchscreen features to meet our current needs. Nevertheless, our next step will be to evaluate similar and applicable features, as they exist within Blaise 5. As it was not possible to accomplish similar touchscreen features with Blaise 5 when the majority of the touchscreen prototyping work was done and many questions linger. Will it be possible to build a similar onscreen keyboard within the Windows Data Entry Program in Blaise 5? Perhaps the iOS or Android Blaise 5 applications will alleviate some of these issues.

7. Summary

As touch-friendly devices become ubiquitous and proliferate the landscape, we can only hope that many of these extra measures to develop useable touchscreen applications become obsolete. Until then, the Blaise menu panel approach to extending Blaise 4.8 instruments to touchscreen represents exciting possibilities moving forward. A significant plus to this method is that it can be created once and reused on multiple instruments with minimal source code changes. We feel the features explored here open up exciting possibilities for the Blaise user community and the possibilities seem limited to one's own imagination!

8. References

Blaise 4.8 Online Help (Version 4.8.4.1899). (2015).

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