Dynamic Keyboard

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1 Introduction:

1.1 Objective:

The problem that we want to address is the limitation of a programmable keyboard being programmed through the software only. This can be an issue by having the keyboard programmed for the personal computer, but not have that programming transfer to a separate computer. By having the keyboard with hardware based programmable keys, the macros that are programmed can be applied to any computer. This is useful due to the fact that there are many computer programs and jobs that require the use of multiple key inputs that can become tedious over time. We hope to apply a switch to the keyboard that will record the combination of keys pressed and apply that to a programmable key so that one can performs their job more efficiently.

1.2 Background:

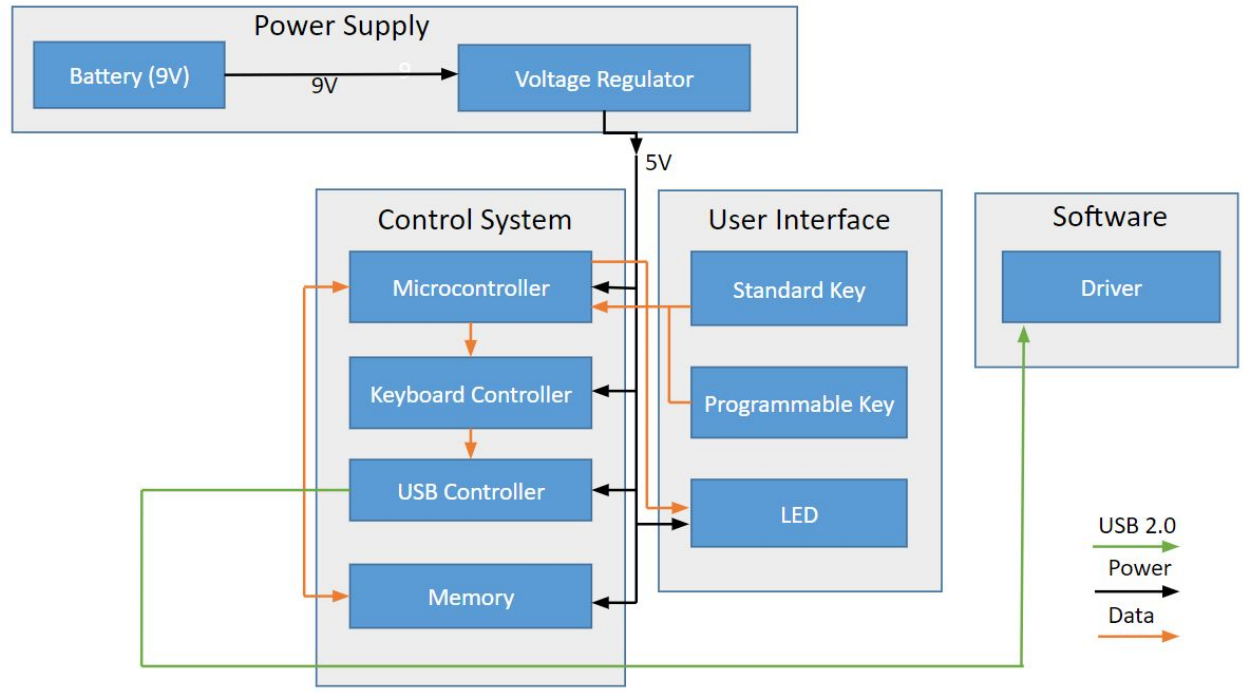
We feel this issue is important because there is a restriction by limiting programmable keyboards to software only. By having a keyboard be programmable through hardware it makes the programming aspect be more accessible and no longer have its location limited. A great example is jobs that revolve around using programs like photoshop where an individual has to press a series of keys over and over again. By having a keyboard that can be programmable to perform the series of keys pressed for a single key, they can perform their job more efficiently. By having a keyboard that is programmable through the hardware, this individual can perform their job with efficiency at any computer, instead of relying on the computer they used to program the keyboard.

1.3 High-level requirements:

- Must be able to perform a combination of 3 key presses with 1 single key.
- Must be able to have up to 9 programmable keys.
- Must be able to rewrite all 9 programmable keys.

2. Design:

2.1 Block Diagram:



The proposed design is of a keyboard with hardware programmable keys that interfaces with a computer. Beyond the standard hardware required for a functional keyboard, our keyboard will also contain a dedicated keyboard controller and flash memory. This keyboard controller and flash memory storage will allow for the programming of macros to programmable keys via hardware. This, in-turn will enable us to meet the design specifications as the keys will be completely programmable via hardware and thus the macros set up on the keyboard will be retained even when switching computers.

2.2 Functional Overview:

Power Supply:

The power supply, provides power to the rest of the the hardware particularly the various controllers in the control system as well as the led's. It is composed of a battery powered source and a voltage regulator that delivers the appropriate power to each of the blocks that require it.

Control System:

The control system is composed of 3 microcontrollers that each process the inputs by the physical keys. The first this the microcontroller that takes the key inputs directly and generates valid interrupts. The microcontroller also handles the LED displays on the keys. Next, the keyboard controller will perform the needed processing for the programmable keys. It will see if a programmable key is pressed and fetch the appropriate interrupt or sequence of interrupts from the memory. Lastly the USB Controller will take these interrupts and interface with the computer via standard USB protocol.

User Interface:

The user interface is composed of both the physical keys, which include both the programmable and standard keys, as well as the the LED's. Both the programmable and standard keys will use the Cherry MX Brown switches and will feed their input into the microcontroller. The LED's will only be present on the programmable keys and will have there output controller via the microcontroller.

Software:

This will be the driver that exists computer side to allow proper communication between the keyboard and the computer.This will communicate with the USB controller and will have to follow the standard interrupt and I/O protocols of the OS it is installed in (most likely x86 Windows).

2.3 Block Requirements:

Power

Battery 9V: Must provide 9V
Voltage Regulator: Regulates to provide roughly 5V and not exceed 500mA
Power Supply: Must be providing power up to 5V

Control System

Microcontroller: Must successfully obtain the switches, have it go through the scan module which leads to the translation module to produce the usb codes for the output module. This will provide feedback from the keyboard to the computer.
Keyboard Controller: interface memory of programmed macros (up to 3 interrupts) to a programmable key
USB Controller: interface between computer and keyboard
Memory: Can store up to 3 inputs per programmable key. Must not exceed the power consumption barrier

User Interface

Standard Key: provides normal functionality (cherry mx brown)
Programmable Key: must have the numpad be programmable
LED Keycap: backlight remains within the power consumption barrier

Software

Interrupt Controller: properly implement hardware interrupt control compatible with common Operating Systems (Windows, Linux, MAC)

2.4 Risk Analysis:

The part of the keyboard design that poses the the greatest risk towards our success is the successful implementation of the Keyboard Controller along with the Flash Memory. As these two components implement the core functionality of the project, which is the hardware programmable keys, and it is vital that the components be properly functional. A failure of this juncture could not only make us unable to reach our design requirements, but also jeopardize the functionality of the keyboard as a whole. Further, this is the one truly innovative component of our design and thus there will be little prior reference available for its proper implementation. Therefore, we must take extra care when implementing the Keyboard Controller and Flash memory components of this project.

3. Ethics And Safety:

In general there is very little health and safety risks. A standard keyboard has very minor health and safety risks. Standard safety issues including having a keyboard that is detachable from the screen, risk of developing arthritis, and discomfort during the use of the keyboard. [3] However, in order to prevent any risk of breaking the safety ethics during the development of the keyboard, we must make sure to follow the safety guidelines that were addressed during the lab safety tests. We must also respect the designs of previous keyboards and give credit where it is due. Another possible ethical issue to address is to accept when an area of knowledge is outside our area of expertise and to obtain help through research and other outside resources. [1]

In order to comply with the first established policy of the IEEE Code of Ethics we shall make sure to establish materials like a voltage regulator in order to limit the amount of power flowing through the device that meets its requirements and does not put the user at risk. We will also make sure to implement the standard safety principles for the safety of the consumer and workers such as no exposed wires, materials that are not toxic, and insulators that will prevent shocks. To comply with the second law of the IEEE code of ethics we will establish all interests and address when there is a conflict between them. If there is a conflict of interests, we will try to resolve the conflict on our own. If the conflict can not be resolved, we will bring an outside party to give their input. The third code of ethics can be addressed easily due to the range of available information on programmable keyboards. If there is a portion of the project we do not understand, we will apply research into the area until we establish an understanding.

The fourth code will be addressed by not performing any acts of bribery or to accept any forms of bribery. It shall also be addressed by reporting any case of bribery that occurs during the development process. [1]

The fifth code will be addressed by making the dynamic keyboard follow the general design that is best understood by the general public. Computer keyboards have existed for decades now and has followed a similar design throughout its development. We will make sure to follow this general design so that it can still be easily understood by the general public. The sixth code of ethics will be addressed by performing what we can do with our knowledge. If we have an issue during the development, we will seek help from the TA and course staff when facing an issue that cannot be solved by us. The seventh code of ethics will be addressed by taking all criticism from the assigned TA, course staff, and fellow peers. We will work together in order to resolve any issue that is addressed by outside criticism. The eight code of ethics will not be an issue by creating a product that can be used by anyone and address any moments of discrimination during the production process. The ninth code of ethics will be resolved by following the safety principles that were addressed during our safety test and to follow all the principles established during the safety training portion of the course. The tenth code of ethics will be addressed by offering assistance and guidance to fellow students and partners in order to provide improvement in both the product and the individual behind it. [1]

We will honor the 1.5 ACM code of ethics by looking into the patent of any design aspect we are considering to use and make sure not to wrongfully use something that will break copyrights. We will honor the 1.6 ACM code of ethics by giving credit to all design aspects that have already existed such as the general design of keyboards and the concept of a programmable keyboard. We will honor the 2.1 ACM code by not using materials that cut in costs or quality of the product. We will make sure to use materials that are for the best of our design and not place peers or consumers at risk. [2]

References

[1]Ieee.org, "IEEE IEEE Code of Ethics", 2018. Available: http://www.ieee.org/about/corporate/governance/p7-8.html. Accessed: 6 Feb 2018.

[2]acm.org, “ACM Code of Ethics and Professional Conduct,” 2018. Available: https://www.acm.org/about-acm/acm-code-of-ethics-and-professional-conduct#sect2. Accessed 6 Feb 2018

[3]workplaceohs.com, “Computers,” 2018. Available: http://workplaceohs.com.au/hazards/office-safety/computers . Accessed: 6 Feb 2018