The Asian Mule in Cyberspace: Building Game Controllers from Locally Appropriate Materials

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Abstract

Over the last twenty-five years small 100-125cc motorcycles have become the “mule of Asia” - a common mode of transportation for both passengers and goods. This paper describes a number of novel and distinctly Asian game input devices for playing a futuristic motorcycle computer game that takes the mule of Asia into cyberspace. The controllers are constructed from cheap, readily available, local materials and in addition to their functionality the design and choice of these materials is presented as a commentary on many aspects of life in modern South-East Asia.

Keywords

Game input devices, input devices, physical interaction, human factors, Asia, culture.

1. Introduction

South-East Asia is a land of iconic imagery and cultural contrasts - a mixture of the old and the new, the traditional and the modern. One of the significant changes in South-East Asia over the last twenty-five years has been the proliferation of small 100-125cc motorcycles [1] and this modern “mule of Asia” [2] has become a common mode of transportation for both passengers and goods. This paper presents a number of novel game input devices - the first of which are designed for playing the futuristic motorcycle computer game GL-Tron [3]. The devices are constructed from cheap, readily available, local materials that give them a distinctly Asian feel and thus the mule of Asia is thrust into cyberspace.

In addition to the motorbike controllers, two controllers for car-racing games are also introduced. Each of these game input devices lies at the border of the human-machine interface but beyond their mere functionality for playing games their design and construction also embody and symbolise many aspects of life in modern South-East Asia. The devices themselves provide cultural insight and commentary.

The next section of the paper presents the game controller as both an example and a metaphor for the transformation of newly industrialised economies (NIEs) from imitators to innovators. This innovation - in the form of a hacked game controller – serves as the underlying hardware interface

Figure 1. Sony Dualshock controller (left) and imitation (right).

technology upon which the motorbike and car controllers presented in sections 3 through 6 are built. Section 7 then presents some future directions for this work before Section 8 concludes the paper.

2. From Imitation to Innovation

In the introduction to their volume on NIEs, Kim and Nelson attribute rapid industrialisation to the reverse engineering of foreign products [4]. An example of this is presented in Figure 1. The game controller on the left is the Sony Dualshock 2 controller [5] for the Playstation 2 while the controller on the right is a cheaper copy with a USB serial interface for playing computer games on a PC. Both are available in the original black or translucent island blue colours and so the only real visual distinction between the two is the substitution of Sony's iconic triangle, circle, cross, and square buttons on the Dualshock controller with the numbers 1 to 4 (although still with the same colours). This is imitation, however, Kim and Nelson go on to point out that the processes involved in reverse engineering ultimately lead to research and design and from this, eventually, comes innovation and the ability to produce new products.

The innovation in this case is the addition of a 9-pin D-subminiature connector to the underside of the imitation controller by the author of this paper. See Figure 2. The connector is patched transparently onto the printed circuit board of the controller so that its normal operation is unimpaired but the buttons can now be bypassed so that it can also be used as a generic plug and play USB serial interface. This simple hardware abstraction permits signals sent via the D-sub connector to appear as if they are responses to button presses and joystick movement on the game controller. This is an example of opportunistic design and it enables what Hartmann, Doorley and Klemmer call a "mashup" [6] – the ad hoc design and combination of hardware and software. Rekimoto and Wang use a similar approach by introducing a new type of game interaction, which is interfaced using a hacked Dualshock controller [7].

3. PVC-pipe Motorcycle Controller

The widespread uptake of motorcycles for transportation in South-East Asia means that it is increasingly difficult for owners to locate their motorcycles in high-density motorcycle parking areas at shopping centres. As a result there are accessories available to customise bikes and make them

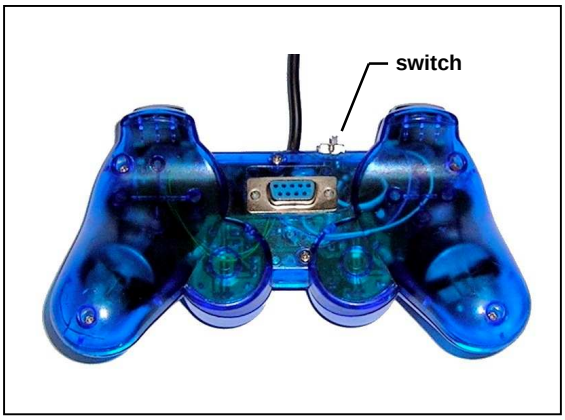

Figure 2. Bottom view of modified controller.

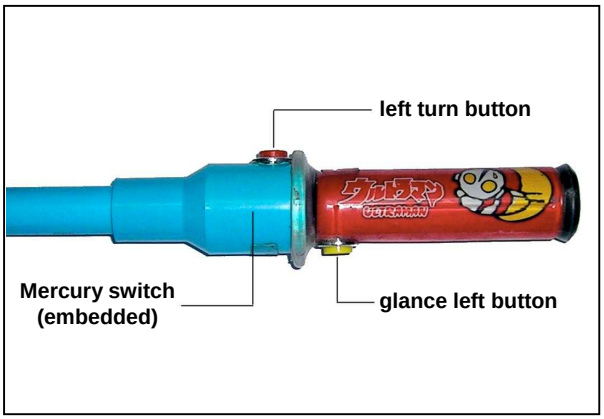

Figure 3. PVC-pipe motorbike handlebar.

stand out from the crowd. These accessories include custom hand-grips featuring Japanese cartoon characters which are popular throughout Asia [8].

Another feature of the urban landscape in Thailand is the ubiquitous blue PVC (polyvinyl chloride) water-pipe. It can be seen along most streets not only for carrying water but it is also used as a cheap construction material for everything from clothes dryers to flagpoles and shop signs.

The design of this first GL-Tron motorbike controller used measurements from the handlebars of a real motorcycle and combined Ultraman hand-grips with PVC water-pipe to produce the handlebar shown in Figure 3. GL-Tron is an open-source 3D motorcycle game based on the famous “lightcycle” scene from the 1982 Walt Disney movie Tron [9]. Buttons on the handlebar provided the ability to turn left and right while buttons on the back of the hand-grips enabled the user to glance left and right within the game to look for opponents. In addition a mercury tilt switch was embedded within the handlebars so the bike could be accelerated by rotating them. The controller reflects the proliferation of motorcycles, the influence of Japanese animation and the abundance of PVC water-pipe.

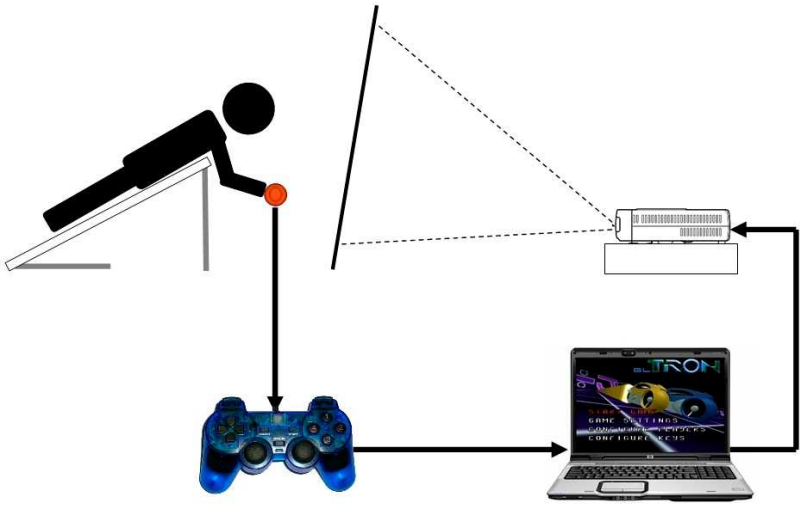

Figure 4. “Immersive” GL-Tron setup with rear-projection screen.

Using a data projector and a rear projection screen, an immersive environment was constructed where players could lie on a sloping table with the game filling their field of view. See Figure 4. Two speakers provided stereo sound on either side of their head and the controller was used to provide a novel first-person interactive game experience.

4. Real Motorbike Controller

A further step towards the use of everyday items in computing environments [6] was to augment real motorcycles and then use them to play GL-Tron. A "breakout box" was constructed as an additional hardware abstraction over the modified controllers D-sub connector that allowed the easy connection of wires to sprung speaker terminal connectors. These wires were then connected to buttons which were mounted onto small pieces of PVC water-pipe and cable-tied onto the front of motorcycle handlebars as shown in Figures 5 and 6. A mercury switch mounted on the accelerator hand-grip also allowed these movements to be captured so that players could use the accelerator to control their in-game motorcycle.

In addition to the first-person perspective mode described in section 3, GL-Tron also includes a split-screen mode for multiple players. With a suitable surface to use as a screen and a data projector, up to four players can play at the same time.

5. PVC-pipe Car Controller

In their study of motorisation in Asia over the last twenty years, Senbil, Zhang and Fujiwara note that Thailand is among a group of countries with a significantly higher rate of motorisation in terms of passenger cars [10]. It is against this backdrop that we extend the game controller as a cultural symbol to also include interfaces for playing car-racing games. See Figure 7.

Once again in this design the prevalence of iconic Japanese cartoon characters is reflected in the Doraemon hand-grips used for steering. The chassis of the "vehicle" is also made from PVC water-pipe with multiple connectors, diameters, and angles reminiscent of the circuitous plumbing designs visible along many Asian streets.

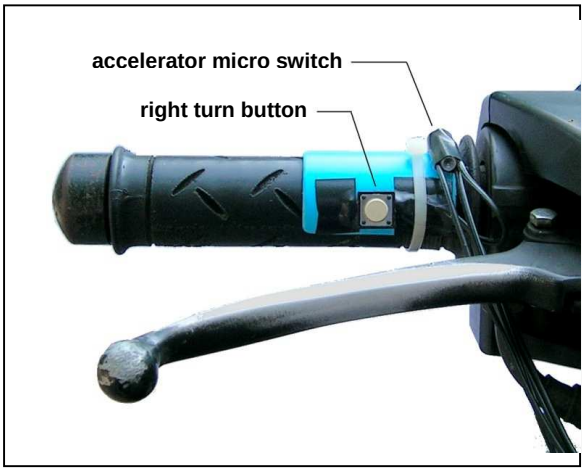

Figure 5. Right-hand side motorbike grip.

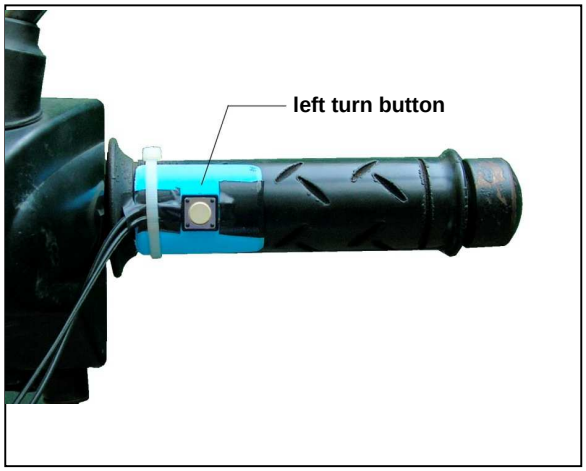

Figure 6. Left-hand side motorbike grip.

Figure 7. PVC-pipe car controllers.

Rubber bands provide physical resistance within the steering and pedal assemblies and these were collected from meals served by restaurants and street vendors. They symbolise over-packaging where every styrene box is held shut for the journey home by a rubber band and every bag must be placed within another bag to carry it. This is at a time when international fast food restaurants have reverted to paper packaging in an attempt to reduce waste. Throughout Asia rubber bands are also used to skilfully secure all kinds of liquid inside yet more bags in a way that the West reserves for the transportation of goldfish.

5.1 Steering

The controller's "steering wheel" shown in Figure 8 is more like a flying yoke than a wheel but its design is constrained by the available PVC connector types. This same constraint can be seen in the many and varied plumbing designs as well as other local products constructed from PVC water-pipe. While it would be straightforward to construct an octagonal ring or wheel using forty-five degree angle connectors the size of the resulting wheel would be too large for this chassis.

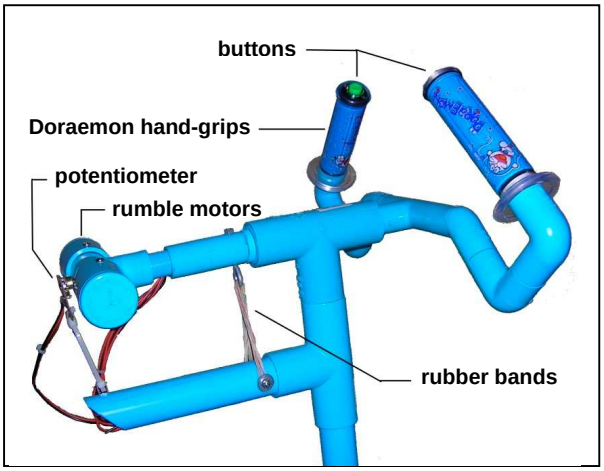

Figure 8. PVC-pipe steering assembly.

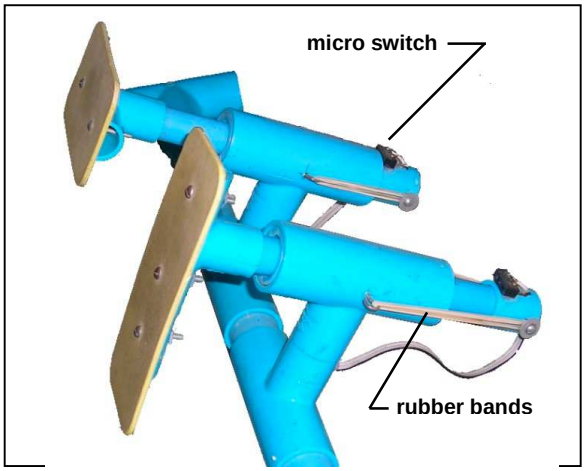

Figure 9. PVC-pipe accelerator and brake pedals.

The car controller provides analogue steering via a potentiometer mounted at the end of the steering column, which is connected to the x-axis of the left analogue joystick. The switch shown in Figure 2 is used to switch between this external potentiometer and the joystick's own. Two rumble motors are also mounted horizontally on the steering column for force feedback and two multi-purpose buttons are also mounted in the end of the hand-grips.

5.2 Accelerator and Brake Pedals

Figure 9 depicts the accelerator and brake pedal assembly. The pedals are implemented as pistons with rubber bands again providing resistance for the driver to push against. These work using the same mechanism for activating the brake lights found in many passenger cars. With no pressure applied to the brakes the sprung resistance of the pedal holds a normally closed switch in the open or "off" position. When the pedal is depressed the switch is released and the car's brake lights are activated. Two small micro-switches mounted on the end of each pedal piston provide this same functionality. The switches are connected to the modified USB controller via two pins of the D-sub connector which are in turn mapped to buttons within the computer game.

Unlike the analogue steering described in the previous section the pedals only provide pure digital "on" and "off" functionality. Despite this, many drivers have reported experiencing a compelling "illusion" where they felt that depressing the pedal further made the in-game car accelerate more quickly.

The chassis itself is held together by four larger diameter "sleeves" with holes drilled along their length. This enables adjustment for different driver sizes as well as the disassembly of each car into three sections for transportation.

Figure 10. Bamboo car controller.

Figure 11. Bamboo accelerator and brake pedals.

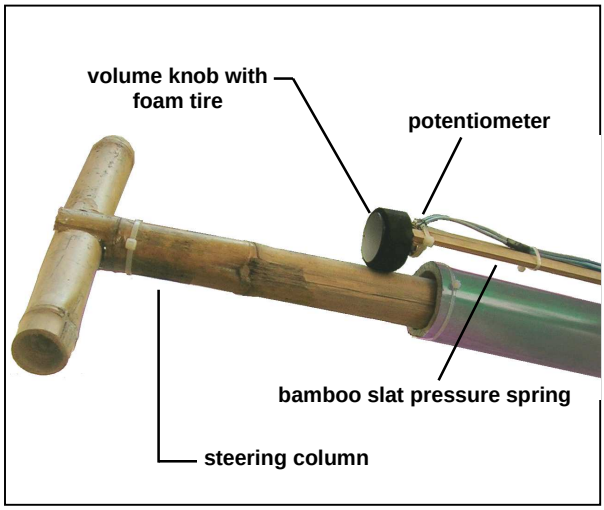

Figure 12. Bamboo steering assembly.

6. Bamboo Car Controller

Bamboo is a strong yet flexible, multi-purpose building material which can also be used as a food source. It is an iconic Asian symbol that has both economic and cultural importance. A Formula One style car controller built from bamboo can therefore be seen as a symbol of the contrast in Asia between the traditional and the modern. See Figure 10.

The chassis of the car is constructed entirely of bamboo and rope with the exception of nails and some cable-ties used to secure the electronic components and the horizontal slats for the front and rear aerofoils. Two bolts can also be seen in Figure 11 which secure the lever-style pedals. Rubber bands are again employed for resistance and the micro-switch operation from the PVC car pedals has also been replicated.

As with real Formula One cars, it was decided that the design of the bamboo car should incorporate a removable steering “wheel” to facilitate entry and exit into the “vehicle”. The shaft of the wheel is inserted into the larger diameter of the steering column. See figure 12. A potentiometer with a large volume knob sits on top of the shaft and it turns in response to the turning of the steering wheel shaft. A foam tyre glued around the knob increases friction and a single bamboo slat secured along the length of the steering column acts as a spring applying pressure to keep the potentiometer in contact with the steering shaft.

7. Future Directions

The modified controller at the heart of the game interfaces described in the preceding sections has already been used as the enabling technology in a number of other projects. These include: a dance mat, a virtual pinball table, a multi-player version of Guitar Hero [11] which allows up to ten people to play simultaneously, and a quiz game for use in classrooms.

A curriculum is currently being planned to incorporate game hardware interface design and USB programming within a university Computer Information Systems course. A modified controller in conjunction with the breakout box described in Section 4 provides a simple, cheap and re-configurable USB hardware platform for testing student projects.

Dualshock-like USB controllers also show potential as a cheap robotics platform for education with plug and play hardware that provides access to two motor outputs, four analogue inputs, and 16 digital inputs. The Nintendo Wii Remote also makes new and interesting directions for these type of game interfaces possible with the inclusion of Bluetooth wireless communication, accelerometers, audio, an Infra Red camera, and existing software libraries [12].

8. Conclusion

This paper has presented four novel game controllers for playing motorcycle and car-racing computer games which use a modified USB game controller as the hardware interface. In keeping with the hacker tradition of re-using and re-purposing everyday objects in innovative new ways the controllers have been constructed from cheap, readily available, local materials including PVC water-pipe, bamboo and even augmented motorcycles.

Beyond the functionality of the controllers they also symbolise many aspects of life in South-East Asia. These include: the transformation of NIE countries from imitators to innovators, the influence of Japanese animation, the widespread uptake of motorcycles for transportation and the encroaching motorisation of passenger cars, the ubiquity of PVC water-pipe, over-packaging, and the contrast of the traditional and the modern.

References

[1] T.-P. Hsu, F. M. S. Ahmad, and D. X . Nguyen, *A comparison study on motorcycle traffic development in some Asian countries – case of Taiwan, Malaysia and Vietnam*, The Eastern Asia Society for Transportation Studies (EASTS) International Cooperative Research Activity, Tokyo, 2003.
[2] Phuket Travelers Net – Bike-Life Phuket, http://www.trv.net/trv98/bikelife/dream.htm
[3] The GLtron Homepage, http://www.gltron.org
[4] L. Kim and R. Nelson, *Technology, learning and innovation: experiences of newly industrializing economies*, Cambridge University Press, 2000, 3-4.
[5] DUALSHOCK2 Analog Controller, http://www.us.playstation.com/PS2/Accessories/SCPH-10010U
[6] B. Hartmann, S. Doorley, and S. Klemme, *Hacking, mashing, gluing: understanding opportunistic design*, IEEE Pervasive Computing, 7(3), 2008, 46-51.
[7] J. Rekimoto and H. Wang, *Sensing GamePad: Electrostatic potential sensing for enhancing entertainment oriented interactions*, in Proceedings of Conference on Human Factors in Computing Systems (CHI2004), 1457-1460, 2004.
[8] W. Ng, *The impact of Japanese comics and animation in Asia*, Journal of Japanese Trade and Industry, 21 : 4 (Japan Economic Foundation, Japan) July 2002, 30-33.
[9] TRON (1982), http://www.imdb.com/title/tt0084827/
[10] M. Senbil, J. Zhang, and A. Fujiwara, *Motorization in Asia*, IATSS Research 31(1), 2007, 46-58.
[11] Guitar Hero, http://www.guitarhero.com
[12] J. Chung Lee, *Hacking the Nintendo Wii remote*, IEEE Pervasive Computing 7(3), 2008, 39-45.