Play, Explore, Challenge: A design strategy for innovation

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***Abstract*—As robotics engineers, our job isn't to single-handedly change the future. We aren't equipped to do so, because we are specialists in making things that work and do *something*, which is a hard enough task. Sometimes the most significant ways to make a difference are through collaboration, even if that only means paying attention. We get a lot of ideas by taking inspiration from fields outside of engineering and design, and asking others outside our community for their problems. At the end, if all works out, we have a problem worth solving and they get a solution they may not have otherwise been able to achieve alone. And this is a fantastic strategy for innovation. But it's not the only one.**

One question I get, or hear throughout the robotics (or wider) community, a lot is, "How did you come up with that idea?" And the answers typically follow the formula for collaborative influence; "I heard about…" or "Someone approached me about…" and then some form of "…that got me thinking…" Problem, Solution. Of course this seems the most natural, because it's hard to generate a solution to a problem without knowing what that is, but it's never too late to start cultivating the mental soil for readiness. If the roboticist is a fertile ground into which problems can be planted that grow into technological solutions, then the process of design starts much sooner than the illumination of a clear goal, before there are even any seeds to bury.

Assertion: **Building things for fun is as important as building things deliberately to solve real problems.**

I. Play

Preparation for design and engineering is formalized through education, primarily in mathematics and physics, which provide the tools needed to carry out complex technical tasks. This academic approach lays much of the foundation needed for solving new problems but is missing a crucial feature: creativity. This is a much harder subject to teach but it's probably the easiest to practice. And it's at least equally valuable. Sometimes creativity is described as "thinking outside of the box", and in a lot of ways that makes sense. This metaphor represents the notion that "the box" contains conventional wisdom, and "outside" are all these new ideas no one has ever considered. Except for one person – the thinker. So logically, it's either that this person was able to think beyond convention, or that this one person has a different concept of possibility itself. The second explanation is closer to a metaphor of increasing the size of the mental box, where a bigger set of preconceptions allow greater potential for finding or creating new solutions. Not from new ideas, but from a larger set of old ideas to draw from.

This is the core tenet of the concept of *Play*, which is the first of three essential components to a new design strategy for innovation. Play is critical for building a mental database of concepts and experience which can be leveraged for generating new design solutions. Although it's not entirely important that solutions be the ultimate, immediate purpose or goal of a project, building, designing, and testing things "for fun" plays an important role in doing so when needed. What is most important in the process of Play is the aspect which makes it personal. Although many problems have been solved, ideas have been tested, code written, and machines built, that doesn't mean those things are not worth re-visiting or re-doing. There's an element of satisfaction of course, that can sometimes come with programming the video game *Pong* yourself, or building your own computer, or electric DIY scooter, but the benefits extend far beyond the emotional reward. The greatest benefits to personal involvement of any project, even in developing existing technology, are the many lessons, features, interactions, and characteristics of "known" solutions that are rarely taught, and often hidden from view. These subtleties are translational however, and influence the way the mind thinks and approaches truly new ideas. They fill and expand the mental box of conventional wisdom to allow access to what looks like novelty from the outside, but is in reality, connected to threads of familiar personal practice, exercise, and experience.

II. Explore

Sometimes play leads to a spark. This is not the type of spark that immediately represents a new idea, but rather the type that attracts attention. The more powerful type of spark is that which ignites engagement and focus on some particular concept. In a way this reaction can also be labeled 'curiosity', although this is arguably important through all stages of design and development. What matters most is the motivation which follows a spark or curiosity to look deeper into an idea, and to see what it can do. To unwrap it, flip it over, take it apart, and apply it in new ways. This is where experiments might begin, which can be used to connect the fundamental science of existing constructs to untested applications or configurations, but the concept of *Exploring* still does not necessarily need purpose connected to a given problem. Exploration is a natural extension of play, only with less bounds. The two might even occur or progress simultaneously, as one idea is tried and continually pushed to new limits or directions. An important aspect of these activities is the foundation of understanding and knowledge, about underlying mechanics, principles, techniques, and performance.

III. Challenge

Innovation is about change, and change often does not come without challenge. In a similar spirit to the notions of play

and exploration in design and development, the pursuit of a challenge provides benefits beyond the final goal itself. Great challenges in science or robotics are often defined and put forth for the benefit of their solution. If a humanoid robot could do the work of a human, it would be possible to fulfill many harmful, tedious, or understaffed jobs in the workforce, ensuring safety, productivity, and quality of life for many people. Self-driving vehicle also have the potential to improve or save lives. Solving these kinds problems will undoubtedly change the face of modern society, and likely for the better. But there will also be indirect benefits from the lessons learned along the way; in taking risks, in iterating new designs, and simply spending the time exploring the mental box. If play and exploration are a form of elementary design education, challenges are a form of training, to keep those interested in solving new problems mentally and technically fit. This benefits not only the problem at hand, but those to come in the future.

Finding challenges to solve is often a challenge in itself, and a burden owed to the fact that it often starts with the desired outcome. For the sake of learning, experience, idea stimulation, and problem solving exercise, it is worth considering an alternative, to start with challenging problems to solve simply because they are hard. This idea is certainly not new to many engineers, scientists, and hobbyists alike. It is perhaps a bold assertion, however, to suggest this type of engagement or activity be embraced formally in the research and scientific community. To pursue challenges purely out of interest, without initial regard for outcomes in an open and deliberate manner may seem to defy the scientific method, but this is not entirely true. The discrepancy may only be obscured by the notion of awareness, in that it may not be clear why a challenge or problem that is fun to solve is worth solving until it is done and thoroughly studied. This is to say that there is a hard-to-quantify or define correlation between ideas which are intriguing and ideas which have impact, but that it almost always exists.

IV. Conclusion

Finding solutions to real unsolved problems often requires new things; new tools, techniques, or technology. Ironically, this type of innovation has less to do with actually solving the problems though, than trying new things. Above and before all else, innovation comes from new ways of thinking that can only be developed, accessed, and strengthened by free design strategy. This freedom is what feels familiar in situations of play, without restrictions or specific objectives oriented toward predefined novelty or contributions. Allowing freedom to pursue and explore particular ideas, projects, or goals for the sake of curiosity and understanding fosters natural development and strengthening of problem solving skills through the discovery and engagement of technical challenges which may or may not have a direct or immediately clear impact. Following the strategy to play, explore, and challenge yourself in engineering and robotics design facilitates the generation and development of new and innovative ideas.

More simply put: **Building things for fun is as important as building things deliberately to solve real problems.**