FROM THE NOTEBOOKS OF A TROUBLED INVENTOR

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Abstract:
Contemporary inventors and investors are faced with new challenges and difficulties that have not been experienced by past generations of inventors. This basically is the result of the exponential increase in the amount of knowledge and the tough global competition. A magic formula for success does not exist, but following some basic rules to be discussed here, will greatly increase the inventor / entrepreneur's chance for success. Two examples, the Video capsule and a 3D imaging Camera that are based on the author's past inventions are described and analyzed to demonstrate some of the rules

Proposed rules:

1. Try to define a true market need and then see if your technology is a suitable solution. In most cases it will be a mistake to try and push your technology into areas that not necessarily need it.
In other words:
Do not ask what is the use of my new invention, rather, when faced with a market need or challenge try to fit the most promising technology to it, even if not yours, and avoid the NIH ("Not invented here") factor.

2. In many cases success is the result of an interface between two disciplines, one stating the needs and the other provides the potential solutions. Common cases include the interaction between the fields of medicine and engineering or engineering and physics, Engineering providing the needs and physics the solution.

3. Today's inventor should be equipped with a very broad technical - scientific educational background.
In the past, even the greatest and most influential inventors had a rather limited technical education by our contemporary standards, sometimes mechanical intuition and imagination were all that was required to enable a great inventor in producing his world changing invention (J. Watt for example).
New inventions of today are not just mechanical devices; they incorporate more than a single field of knowledge and in many cases require a very broad knowledge perspective.

4. Contemporary invention is a system combining at least some of the following fields of study: Physics, life sciences, Chemistry, Computer science and Engineering.

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Engineering in my humble opinion is “The art of maximizing the S/N”.

5. IP control, a deep understanding of the existing art and patents in the field of the new invention is critical to gain confidence concerning the originality of the new invention.
A thorough research on the freedom to operate and on the novelty is a must before proceeding with the new invention. Remember, if the enterprise resulting from the invention will be successful there is no question that a court action will arrive. the only question is how soon and on what grounds.

6. A true and objective assessment of the market capacity should be made as early as possible to enable the true evaluation of the new invention. One should try to assemble the market size data and numbers from a verity of sources to reduce the chance of mistake in the interpretation of the numbers.

This is part of the rules which are critical for success and would be the fertile soil on which the invention will yield fruits.

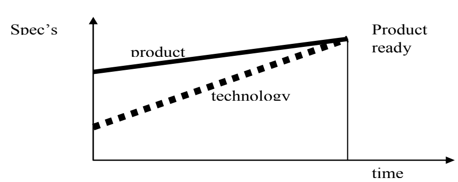
Gabi, sometimes repetitive. Look at 1+6, 2+3+4 and make sure you differentiate

<u>Additional rules:</u>

7. Objectivity:
Try to be open-minded towards your new invention. Even though it my look brilliant to you, ask yourself, “will it really yield profits in the future”? Have you considered alternatives to the new invention? In many cases people are trapped by their own inventions unable to judge them with an objective mind this is commonly known as the NIH factor.
Conclusions: Do not get hooked on your one idea too early.
Examine more alternative solutions to the problem.
and again avoid the NIH factor.

8. Anticipation:
When commencing the design of a new product try to anticipate or predict the direction of progress in the technologies involved and, use some components that are not yet on the market, provided that they will significantly improve the performance of your product Assume that technology will evolve and meet your requirements down the design road. The following figure indicates that during beginning the development of a new idea or product the specifications and the state of art of the technology do not have to match hoping that the technology will evolve at a later stage to match the requirements. One may wonder, is it irresponsible?

Fig. 1: convergence of product spec’s and technology



One may wonder, is it irresponsible? The answer is no!

For if the new design is based on existing technology only:
Patenting will be problematic.
There already exists or will appear in the near future a similar product.
Copying the product will be easy.

9. Consultants:

Expert advice will be required in one or more of the following areas:
Market need.
Technology.
Regulation.
IP.
Finance.

The best consultants are expensive but not always the most expensive. They should be carefully selected since you may have to go with them a long way and their influence and effect on your success will be critical.

10. More on patents:

Patents should be considered as an important data source, sometimes more so than scientific journals and scientific papers. They teach what direction your competitors are considering and what their design philosophy is.
The importance of patents vis a vis papers for the inventor is in the fact that they are directly focused towards your specific application. Journal papers on the other hand should be the source of information on future trends thus enabling the anticipation of future products and components that may improve the design and give you an edge over competition.

$$(S/N)_{\text{patents}} > (S/N)_{\text{journal papers}}$$

When to apply for a patent?
As soon as possible, starting with a provisional
Since research activity around the world is very intensive there is a good chance that at this very moment another person or group is about to embark upon similar solution hence speedy application may save you (Bell vs. Gray).

Two case studies:

1. 3D imaging.
2. Gastrointestinal video capsule (VC).

3D imaging

We had a “brilliant” idea, how to design a camera capable of capturing the range to each and every image pixel. A laser source attached to the camera sends a train of short (10nsec) laser pulses per each image frame. Laser light goes through a beam expander thus illuminating the whole field of view of the camera i.e. FOV=FOI.

Next, the reflected light wall imprinted with objects in the FOV enters the camera and is gated by a solid state device allowing only a portion of the reflected light wall to be captured by the imaging array.

As a result the gray level captured image contains the curvature of the objects in the FOV. The image has to be normalized to account for variation in reflectivity and a color image is captured simultaneously.

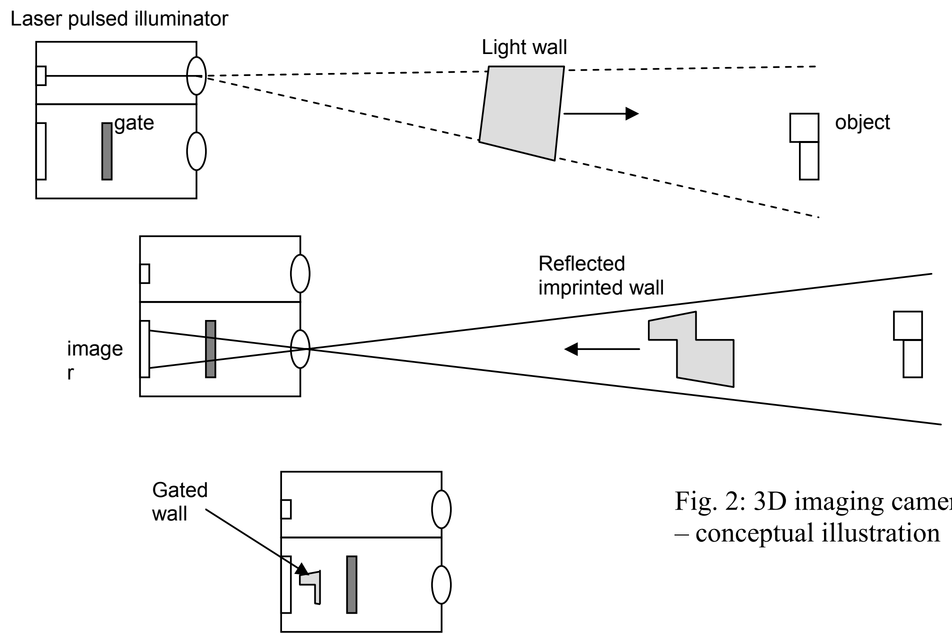


Fig. 2: 3D imaging camera – conceptual illustration

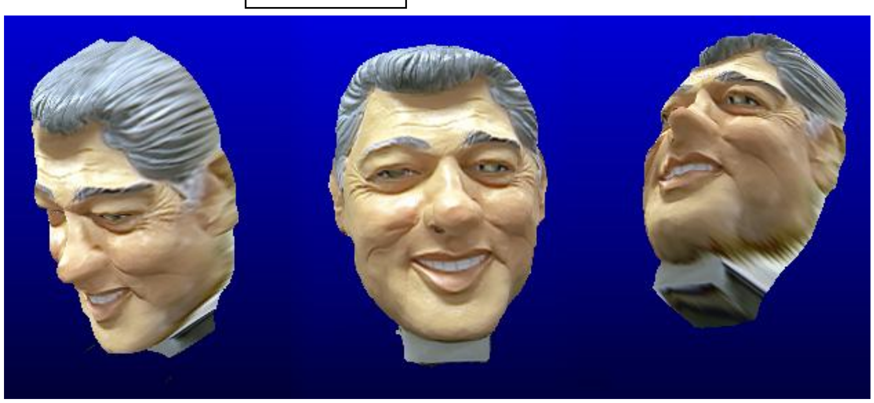


Fig.3: Typical output of the 3D camera
Great, at the beginning the investors loved the idea and money was available.

Now, what shall we do with the device?

TV studio?
Replace the chroma key (blue screen) used today in virtual studios by range key. We demonstrated superior performance and exciting new capabilities.
“Small” problem - super high quality image is required hence, after few years of work we concluded that it was too early.
Try another application…..
By now most of the money has gone……….
Let’s try a new direction, low cost version based on the CMOS single chip device.
Great for mass market applications (gaming)….after 9 years! The company went through restructuring in hope that we are now on the right track.

Even more exciting was the design of a single CMOS chip that can capture the 3D on a single chip without the need for a separate gate as it has a potential for penetration to mass consumer markets where low cost is a must.

The RGB-D CMOS - Camera On A Chip

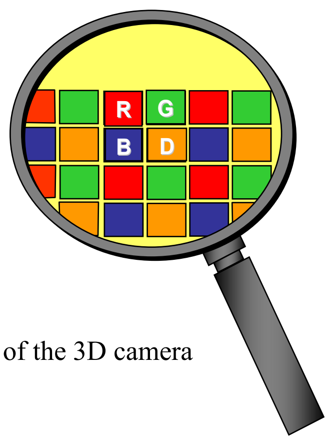


Fig. 4: A CMOS version of the 3D camera

V.C. (also known as the PillCam):

This is an example of a project that went through the right track and ended as a success story.
A need was defined
Technology was not yet available
Low key activity started
Technology surfaced
Intensive activity started
Results are great

Going back to the prediction diagram this was a clear case of required specifications by far ahead of technology as was in existence back in '81.

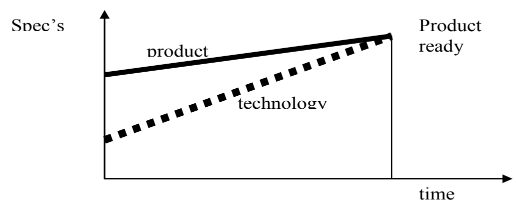


Fig. 1: revisited

How did it all start?
An MD friend complained to me that the existing fiber scope is rigid and very inconvenient to work with for the doctor as well as for the patient. The year was '81 and I had no idea what to do.
A few more years passed and ½", 1/3" and even ¼" CCD cameras surfaced. The commercial drive was the desire for more compact hand held video camcorder. The manufacturers of the fiber bundle endoscope took advantage of progress in CCD miniaturization and thus the CCD endoscope was born.
Yet even the more flexible CCD endoscope was unable to enter the small intestines (SI). In 1992 I was challenged again to find a way to enter the SI, I decided to start a more serious effort to find a solution based on a miniature CCD.

Calculations indicated that we had challenges related to energy, window cleaning, illumination, optics and more. In addition I was often challenged with proving the need for such a product.

Work progressed slowly but the energy problem was a major hurdle! In 1993 I read an article by Eric Fossum in the SPIE proceedings on his invention of a new imager, the

APS (known today as a CMOS imager). The new imager packed all the circuits on a single Si chip and consumed 1% of the power of an equivalent CCD.
A patent was applied for at the end of 1993. Funding however was not yet available for the next 4 years thus work progressed slowly.
1997 - Patent was granted and Given Imaging was born (G. Meron - CEO)
2000 - First human test with Prof. Paul C. Swain as a volunteer
2001 - IPO at the NASDAQ, the first after 9/11.
It is estimated that in 2005 the company will reach revenues of more then $80M!

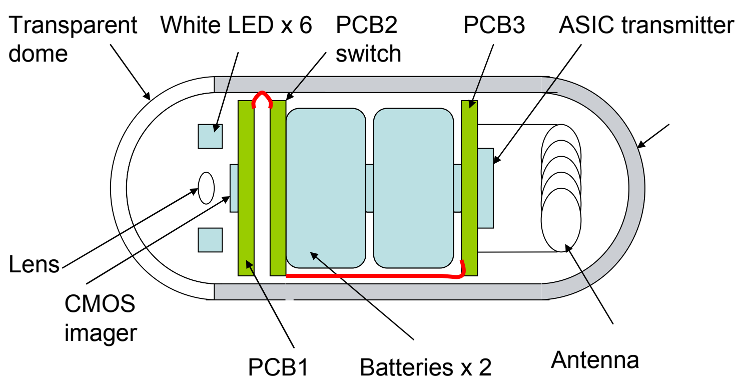


Fig. 5: schematic cross section of the video capsule

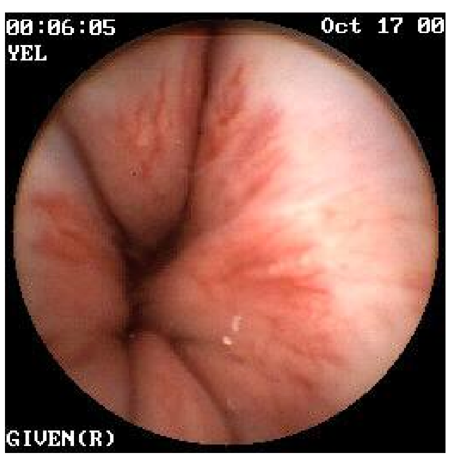


Fig. 6: A typical image captured by the video capsule

Conclusions:
By analyzing the two sample case histories it is observed that:

A project that begins with a clear market need will eventually end up identifying the right technology when it becomes available without exhausting money on full scale development at an early stage thus leading to a successful company.
On the other hand, a very nice technological idea may drag the inventor and the investors into many years of expensive trial and error processes of defining a profitable business case which will require large funds thus leaving the inventors and the initial investors with a diluted asset. We had however many exciting moments while trying to move the project forwards.

References:

1. G.J. Iddan & G. Yahav 3D Imaging in the Studio (and elsewhere…) Proc. Of SPIE vol. 4298 p. 48, 2001.
2. G.J.Iddan, G. Meron, A.Glukhovsky & P.C.Swain Wireless Capsule Endoscopy Nature, Vol. 405 p. 417, 2000.