An artist's process

A discussion of automata, design, and production

by Tim Douglas • Northampton, England • Photos by the author

I've had no training in woodworking, design, engineering, or anything connected to automata. Fortunately, I have a gift of being able to see things work just by thinking.

My interest in automata began when I visited Cabaret Mechanical Theatre in Covent Garden, London, many years ago. I thought, "I could make one," and I did so. It was simple, badly made, and the mechanism was unreliable, but I learned a great deal from that experience.

As I made more, I began to make my pieces more and more complex, capturing a moment in time with which to amuse the viewer. My wife kept telling me, "Make it simple," but I never did. For me, the challenge is in the subject and making that subject work smoothly and come alive. I also like to use a multitude of exotic woods, which show off the beauty and diversity of available materials and add dimension to the piece.

1. *Saucy Seaside.*

2. Mechanism for *Saucy Seaside*.

I have now been making wooden automata for around 16 years and I have 26 pieces on YouTube. Most of my pieces have fairly complex sequential mechanisms that, I hope, enhances the viewer experience.

Automata

To give you an idea of my work, below are some of my automata.

Saucy Seaside (**photos 1** and **2**), 35cm wide x 30cm high x 25cm deep (13¾" x 11¾" x 9¾", respectively). A worm drive turns the main gear and shaft. An additional crank and levers activate the two children and there is a drop cam for the fat lady. I tried to include some aspects of old postcards into the design.

Time for a walk (**photo 3**), 2016; 38cm wide x 30cm high x 21cm deep (15" x 11¾" x 8¼", respectively). A worm drive again powers the main shaft. There is also a double drive that uses identical gears for rotation. Movements are all controlled by cams and levers. The newspaper

3. *Time for a Walk*.

4. *Dracula* (risen).

5. *Dracula* (below).

was copied from old pictures and printed on lightweight paper. The floor was made from pre-cut oak pieces and laid in a herringbone pattern.

Dracula (**photos 4** and **5**), 2018, 34cm wide x 40cm high x 24 deep (13⅜" x 15¾" x 9⅜", respectively). This piece was challenging. The mechanism for lifting the platform and coffin needed to be smooth and fairly quick. I failed several times, until I used AutoCAD to help in the design. The original coffin was made of ebony but was too heavy. I made a copy in balsa wood and painted it black. The other problem was that Dracula had to sit up and turn his head. This meant that the coffin lid could not be attached to the mechanism. Eventually, I worked it out. A mercury switch turns on the current to the LED light in the sun.

Farting Man (**photo 6**), 2019; 34cm wide x 27cm high x 30cm deep (13⅜" x 10⅝" x 11¾", respectively). A worm drive powers a gear on the drive shaft. Seven cams operate the piece. I changed most of the mechanism as I went along. The parrot was difficult, as its wings would not fold down properly when it returned to its upright position.

Pancake Day (**photo 7**), 2011; dimensions unknown (sold). This piece has four gears that reduce the crank speed to 9:1. The frying-pan lift uses a double lever, while the pancake flip uses cotton thread and weights to turn the pancake. The head-turn mechanism has a rack-and-pinion to allow for a full turn.

Marilyn Monroe (**photo 8**), 2015; 34cm wide x 41cm high x 21cm deep (13⅜" x 16⅛" x 8¼", respectively). This piece was based on the scene from the film *Some Like it Hot*. The piece contains two electric fans that are controlled by a cam. Unfortunately, I needed to install a support behind her for the cotton thread that controls her body movement. A local seamstress made the dress for my model. I originally tried magnets to lift the dog's ears, but this didn't work. Instead, I used fishing line through its head and attached the ears to the line to provide the lift.

6. *Farting Man*.

7. *Pancake Day*.

Automata design

I often get requests from people who ask if I could provide plans for the automata that I build. My answer is always "no." The reason for this is not because I mean to be unhelpful or secretive; it is because I do not even draw any plans for myself. Most of them are in my head.

When I have an idea for a piece, I normally sketch designs for the different mechanisms in a drawing book. Even though I have made so many different automata, I always need new mechanisms for each piece.

Designing the mechanics is always the most interesting and challenging part of the build. I have an idea that I think will work, but until I actually make it I am never sure. For example, in my latest piece, *Farting Man*, I included a parrot. The parrot is supposed to fall backwards unconscious, which would make its wings droop down. I assumed that when the bird was set upright again, gravity would act on the wings and return them to their proper position. I was wrong—they stayed up. I needed to adapt the mechanism to compensate for this. I tried using copper for the wings, but in the end I used a different hinge system.

Sometimes I find it difficult to think of the mechanics to achieve a certain action. However, I learned over the course of time that there is always an answer. Discovering it just requires perseverance and keeping it as simple as possible.

The more pivot points and mechanisms there are in a piece, the less efficient the action becomes. The design must be smooth in operation, have the correct speed and be able to operate with the provided drive.

I normally use a worm drive connected to the crank handle. This interacts with the main gear, which is mounted on a shaft that provides the drive to the cams.

During the design process, I calculate the timings. My wife aids me by using a stopwatch while I go through the actions. This will dictate the number of teeth on the main gear. For instance, if I plan a 25-second complete operation, I then design a 25-tooth gear, as I estimate that the crank should be turned on a one-second cycle.

My automata often have six or more operations and I normally use cams and levers to control the movement. Cams can be designed to start and end the action when I want, with the speed of the action controlled by making steep or shallow curves on the cams. The levers, or cam followers, then control the mechanism. I have to calculate the timing to ensure that all the operations are completed within the single rotation of the main gear.

I also like to include sound effects and lights. For these I use cheap audio circuit boards, microphones, speakers, and low-voltage (9V) bulbs.

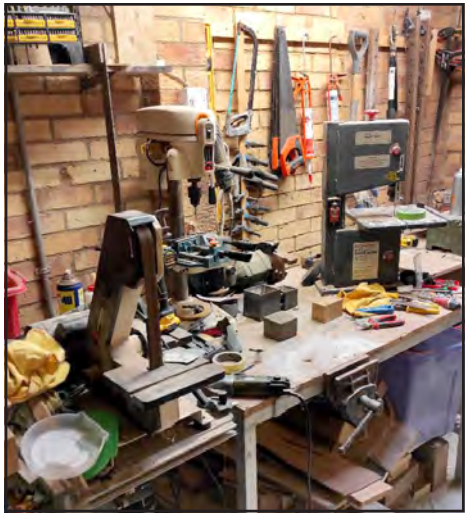
I do use AutoCAD to design certain aspects of my automata, and I also use a free gear program. On several occasions I have tried to make complete 2D drawings, but it is so complicated that I inevitably give up. I also think of improvements as I am making the piece, so now I don't bother with drawings at all. I allow an area in the automaton for each operation, then find ways of making it fit as I go along.

Over the years I have built up an audience and some of my automata have reached over 450,000 views on YouTube. Favorites are *The Ghost* and *French Maid*. My own favorite is *Stolen Kisses*, while my wife's is the *Dalek*. I made it for her one Christmas, and it comes with the appropriate sound effects.

Workshop

Some of you may be interested in seeing where and how I make my automata. My shop occupies one side of a single-car garage (**photo 9**). Most of my benchtop tools are here. The other side of the garage is shown in **photo 10**. As you see, I don't have a lot of room.

8. *Marilyn Monroe*.



9. The author's workshop, occupying half of a garage.

10. The other side of the garage.

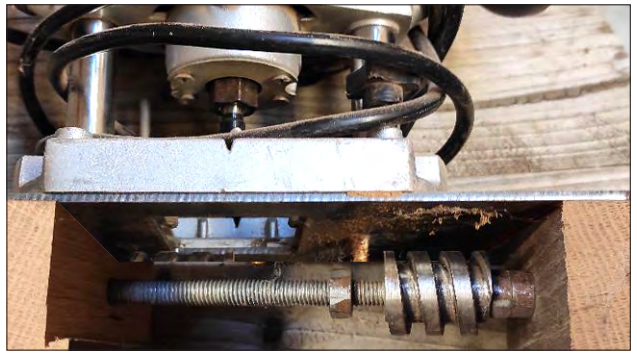
I know my workspace is untidy, but that is how I work. I have tried many times to work in a clean, uncluttered fashion, but I can't. I am so focused on what I am doing that tools and parts just pile up. The only problem is that I can never find what I want. I could have tidied it up before I photographed it, but that is not how it is.

I have several pieces of equipment that I primarily use, so they are not moved. **Photo 11** shows my Proxxon miniature table saw. This is an expensive tool, but very good. It is surprisingly powerful and accurate.

Photo 12 shows how I use a router to make my worm drives. A pre-cut metal worm that I had made is mounted on the threaded shaft. This is used as a template. To cut a new wooden drive, I install a blank round piece of 30mm diameter (1¼") wood on the same threaded shaft, using nuts to secure it. When the shaft is gently turned by hand, a 5mm diameter (approximately ¼") metal pin follows the groove in the metal template. (In the photo, this pin can be seen to the left of the worm, not engaged with it.) This enables the router to slide and copy the metal worm onto the wooden blank.

My small bandsaw (**photo 13**) is perfect for vertical cuts and also for making gears. I use it a lot. The sander (**photo 14**) is useful for 90-degree sanding. I also have a flatbed sander.

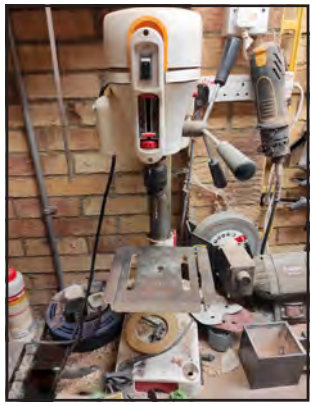
11. Proxxon's miniature table saw.



12. Making wooden worms using a router.

13. The benchtop bandsaw.

14. Vertical belt sander.



15. Drill press with depth gauge.

The drill press (**photo 15**) is essential for vertically drilling holes. It has a depth gauge, which allows me to accurately drill holes to specific depths.

My desire in writing this article is the hope that it will encourage other automata makers to attempt more ambitious projects. Remember, you can make up your own rules to suit yourself. As long as it works, it's good! A1.

Web Links

To learn more about Tim Douglas's work and see his automata in action, please visit his website, http://timdouglas-automata.com or go to https://www.youtube.com/ and enter "Tim Douglas Automata" in the YouTube search engine.