Success Story

In-House Production Automation & Co/Robot Opportunities for Clever Sweets, UK

Planning and implementation of automated equipment, and identification of future opportunities for cobot tasks

In-House Production Automation & Co/Robot Opportunities

Company description

Clever Sweets is a small confectionary business run by a single individual with a background in food science and technology having previously worked in product development for a major multifaceted food PLC. This background NPD expertise has led to the formulation of the LouLou's Lollies; a 'guilt free' lollipop. Every LouLou Lolly is sugar free, contains 100% of the recommended daily allowance of Vitamin C, and uses only natural flavourings and colours. The product was launched in 2013 after several years of research, with sales channels online and through a growing number of retailers. Currently production of LouLou Lollies is subcontracted out, and Clever Sweets are now wishing to gain more direct control over the process(es) by bringing production in-house to their premises in South Lincolnshire.

SME Support Activities

As sales volumes increase, Clever Sweets have engaged with the COTEMACO SME support programme to assist with basic automated equipment layouts in the new facility, and identify how to support further sales growth with the minimum of staff.
The basic production stages are:

1. Ingredients blending and heating.
2. Deposit blended mixture to moulds.
3. Add sticks before mixture hardens.
4. Cooling.
5. Demoulding.
6. Wrapping.
7. Boxing.

Clever Sweets desire to keep ingredients blending and heating (step 1) as a manual process for the present time for 'artisanal' control over the process, and further development of the precise temperature protocols required for product texture, and to avoid heat damage to sensitive ingredients.
Although flavours vary, the format for all LouLou Lollies are a standard 9g, 23mm ball on a 4mm diameter, 89mm long bio-degradable round stick. This allows for dedicated automation to be implemented for deposition into moulds (step 2), and wrapping (step 3). The selected depositor (Figure 1) can be readily adapted with different nozzle plates and piston configurations to accept a range of different moulds and is capable of depositing outer and inner product parts separately for two-colour or two-component products. These capabilities allow for an increase in Clever Sweets product range at a later stage. An Indexing mechanism will take moulds through the machine and make the deposit. Initially moulds are fed to the machine and removed manually to be set aside for cooling. The depositor is capable of 30kg/h, representing a production rate of

Figure 1. Depositer (Loynds Mini)

c.3300 lollies/h. The selected dedicated bunch wrapper (Figure 2) can operate at up to 115 lollies per minute (6,900 lolly/h) and would be able to wrap the maximum output rate from the depositor, and additionally be able to also support a 2nd depositor added at later stages when production throughput grows beyond the capacity of the single depositor.

Figure 2. Bunch Wrapper (Loynds BL-04).

The initial production layout incorporating the desired manual blending and heating and utilising the dedicated depositing and wrapping automation is shown in Figure 3. This configuration for continuous production would require 3 staff;

- operator A for blending loading product and moulds into the depositor,
- operator B for collecting moulds from depositor output, adding sticks and placing onto cooling tables,
- operator C for demoulding, and filling the wrapper infeed hopper, and returning empty moulds to the depositor infeed.

Since the wrapper outputs to a tote bin holding approximately 1h of production this is a process buffer and does not need continual attendance. Totes of wrapped lollies can be accumulated in the boxing area until end of the production batch and all staff can combine to execute the boxing.
Alternatively, the system could be run on a batch basis with one operator performing activities A, B C in sequence.

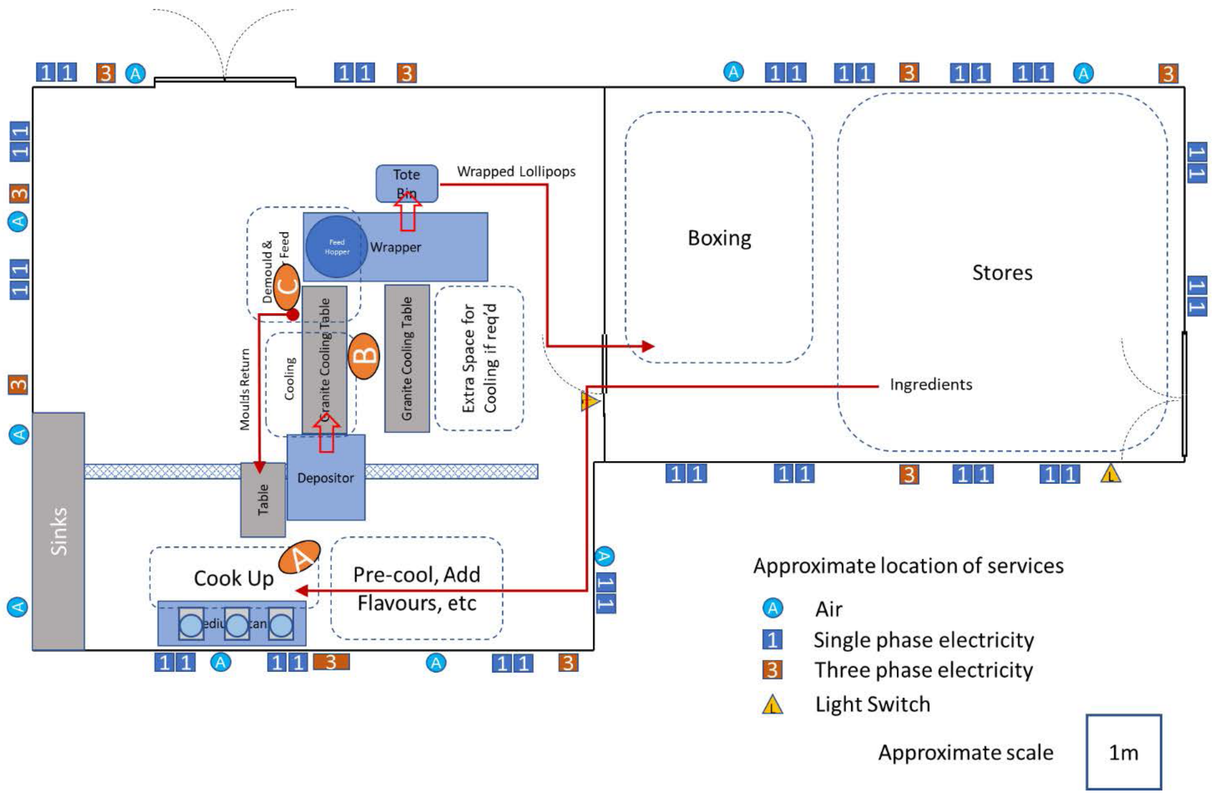

Figure 3. Initial Layout

Opportunity for Cobotic Automation

The initial inhouse production line will use manual operatives for flexibility and ease of refining process. As operations become more standardised there is good scope to introduce cobotic automation.
The lolly production stages are:

1. Ingredients blending and heating.
2. Deposit blended mixture to moulds.
3. Add sticks before mixture hardens.
4. Cooling.
5. Demoulding.
6. Wrapping.
7. Boxing.

Step 1 will be kept manual for process control reasons, and this operative (A) can also feed moulds and product to the depositor. Steps 2 and 6 have dedicated automation in place. The remaining operations, 3, 4, 5 and 7 between the output from the depositor and input to the wrapper are repetitive yet well-structured and thus are candidates for cobotic automation.

Potential Station 1 – Stick Placement

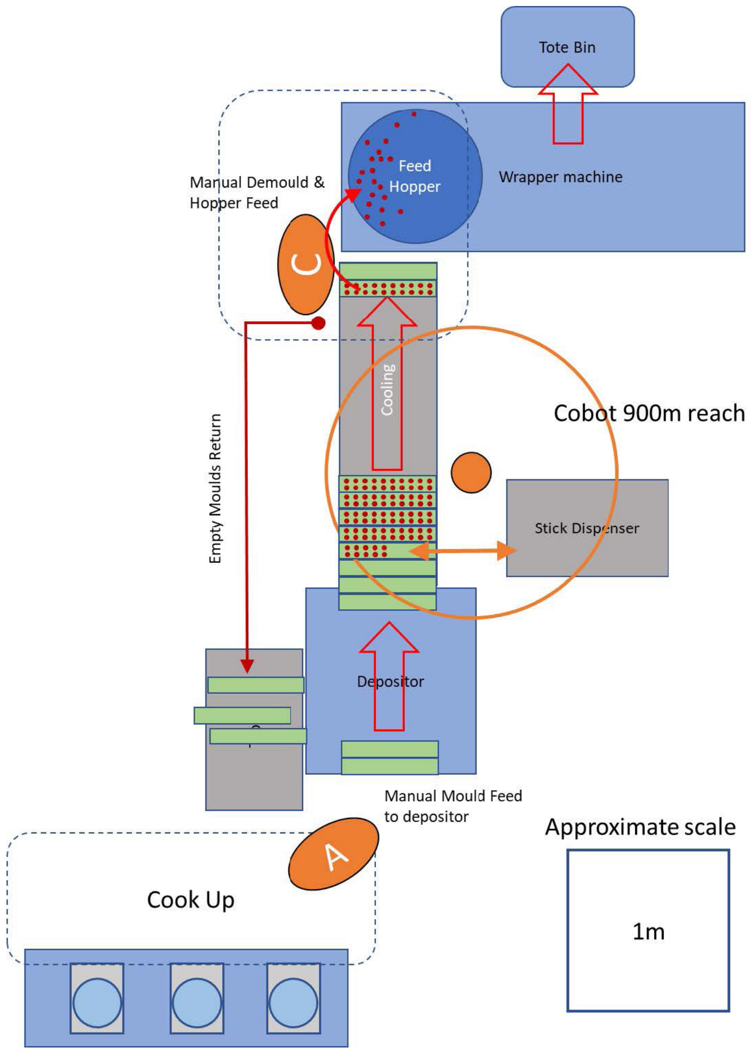

Figure 4. Stick placement cell

There are 20 lolly recesses in each mould and at maximum throughput of 21.6 s/mould, a stick would need to be placed every 1.08s. Very little (if any) process sensing is required as moulds output from the depositor are at known locations, the recesses (stick destinations) are at fixed geometry within each mould, and cooling rack (station output) is at a fixed location.
In the proposed basic cell (Figure 4) the robot would collect several sticks at a time using a multiple jawed gripper tool capable of holding 5, 10 or 20 sticks from a stick dispenser. Transferring several sticks at once reduces travel time within the cobot cycle. Depending on whether the sticks are supplied predominantly aligned or randomised (Figure 5), the dispenser could be as simple as a feed wheel, or require a vibratory feed or other mechanism to align sticks before grasping. Once gripped the cobot would then travel to the known fixed recess locations to place sticks into the setting

lolly bodies. There is a trade-off between size, weight and unwieldiness of gripper, and the number of travel motions required in the cycle for one mould.

Predominantly aligned *Random*

Figure 5. Variations in stick supply format

Potential Station 2 – Mould marshalling

Assuming moulds are 100mm wide and cooling time (step 4) is 10 minutes, c.3m of cooling table is required at the maximum depositor throughput rate. If racks are 150mm and cooling time is 20 minutes this increases to c.8.3m. This could be accommodated along a cooling conveyor, however as space within the Clever Sweets production facility is limited. An alternative would be to use a cobot to marshal moulds to and from cooling racks (Figure 6) to reduce footprint of the cooling process. There is a structured environment and little (if any) process sensing is needed. A marshalling cobot would collect moulds after stick placing and deliver them to a rack where they would reside for the required cooling time. After placing a warm mould on the rack, a cooled rack would be collected and delivered to the demoulding station. The stick placing and demoulding processes could be either manual or automated.

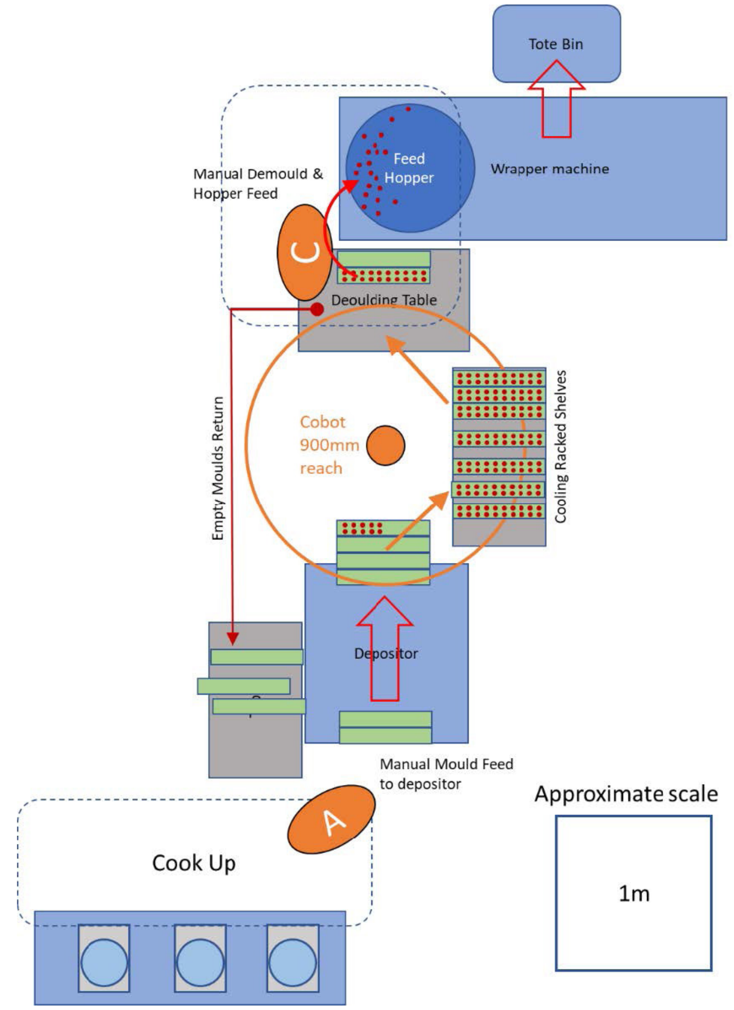

Figure 6. Mould marshalling cell

Potential Station 3 – Demoulding

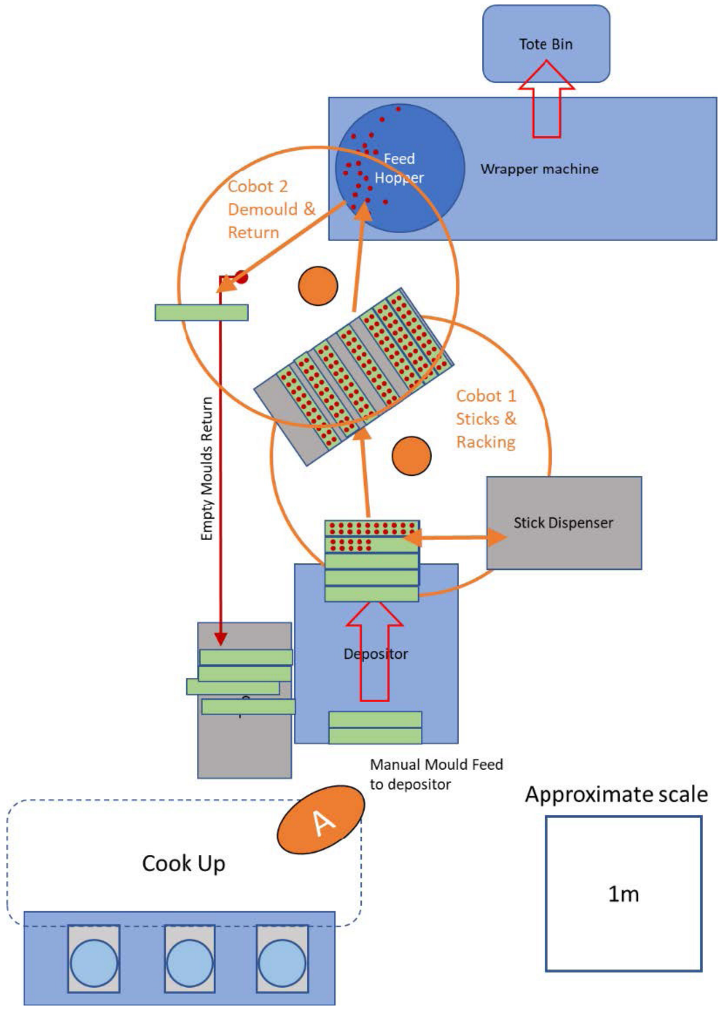

Figure 7. Demoulding cell

The demoulding process is repetitive and requires repeated manual exertion of forces to deform the moulds to eject the lollies. The demoulded lollies than have to be lifted to tip into the infeed hopper of the dedicated wrapping automation. This task could be usefully automated for long-term worker health and safety as well as process benefit. The cobot would collect moulds with set lollies from either the end of a cooling conveyor, or from cooling rack - these locations would be fixed and not require any positional sensing. The moulds would be pushed against a fixture to deform the mould and release the lollies directly into the infeed hopper. This application would require a higher payload cobot due to the need to resolve the demoulding forces through the cobot arm. Emptied moulds would be placed onto an inclined chute to return them to the start of the process ready for manual inspection and infeed to depositor. This demoulding could be combined with the stick placement cobot to completely automate the processes between depositor and wrapper (Figure 7).

Figure 8. Box

Potential Station 4 – Boxing

The current boxing format for LouLou's Lollies is a 10-piece outer box (Figure 8).
The output from the bunch wrapper is up to 6,900/h (1.9 lollies/s) in a random orientation from an outfeed chute. It is not feasible to individually identify, grasp and pack lollies at these speeds and cobotic boxing will need to accept this as an input.
Whilst not an ideal starting presentation, machine vision identification of the sticks is possible as they are the only straight parts in the view and are relatively long compared to the ball parts of the lollies. This machine vision generated positional data would define grasping locations and bin-picking algorithms could be employed. A basic pinch grip on the end of the stick would be used with jaws shaped to stick diameter to accommodate any slight sensing misalignments. This grip would allow lollies to be placed specifically into one of the slots in the box.

Implementation

At the time of writing, the depositor and wrapper have arrived on site and have been positioned according to the layout drawing in Figure 3. The majority of other equipment has been purchased and is available. Clever Sweets are currently in a funding round for investment to engage operational staff, once in place the initial manual line will be commissioned and production started. Once business has grown to sufficient levels, the cobotic roadmap plans will be revisited to confirm they still meet business needs.

Impact of COTEMACO support on the Business

The MD of Clever Sweets commented on engagement with the COTEMACO programme saying...
"COTEMACO enabled the detailed planning of the layout for a new manufacturing operation, optimising the workflow and accounting for the outputs of each machine. This gives a sound foundation for the next step, which on investment will be the creation of a fully automatic process. This is key to the mid-term success of the business".

Interview

How could COTEMACO support you?

Via the SME support programme, COTEMACO engages with SMEs from the automotive and food sectors through field labs. These regional field labs in the UK, the Netherlands, Belgium and Germany are showcasing key production steps in the automotive and food industries, in

order to tackle current low sectorial awareness and knowledge gaps. The field labs will exchange knowledge on different manufacturing tasks, such as handling and (un) loading.
With the COTEMACO programme, manufacturing SMEs are guided through the process of adopting collaborative robotic and shop floor digitalisation technologies, from the exploration of technological opportunities to the detailed definition of a business plan.

What is COTEMACO?

The project, which is an initiative of Interreg North-West Europe, aims to support around 60 SMEs in the automotive and food manufacturing industries with so-called „test environments" and to encourage them to integrate collaborative robotic systems and digital technologies into their business. Accordingly, in addition to increasing production flexibility, the relocation of production abroad will be curbed and the number of jobs in manufacturing increased, which will generally lead to an improvement in the competitiveness of the companies involved.
In the project new technologies are implemented in application examples - the aim is to move from the prototype in the laboratory environment to the transfer to production, taking into account the legal situation and certifications.

You want to become part of COTEMACO too?

You are interested in further Best Practice implementations?

Then visit our website at:
www.robot-hub.org/cotemaco

Implementation partner:

University of Lincoln – National Centre for Food Manufacturing

Lincolnshire County Council

FRPERC Food Refrigeration and Process Engineering Research Centre

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