Introduction to Industry 4.0 and Industrial Internet of Things
Prof. Sudip Misra
Department of Computer Science and Engineering
Indian Institute of Technology, Kharagpur

Lecture – 60
Manufacturing Industries – Part I

So, right now, we are in a different type of company a plastic based company. The name of the company is Grohill plastics which is in Unjha in Gujarat. And this particular company, it is a small scale company and what it does is that it takes the raw plastic material and prepares the mould the cast for basically, the battery the basically the mould of the, the plastic container that holds the batteries, right. So, that plastic container is made over here by them and so, they use PLC based machine, it is a small scale machine, but you know so, we will come know about what this particular machine does and we will also have a look at you know the P L C panel that is there in this particular machine. So, I have with me Mr. Yadavs, Mr. Santhosh Yadav, one of the executives of this company.

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So, Mr. Yadav could you please explain the process that is followed over here in order to prepare this frame that is made for the batteries, the plastic batteries. [FL] a material [FL] cover [FL] colour [FL] use [FL] plastic [FL].

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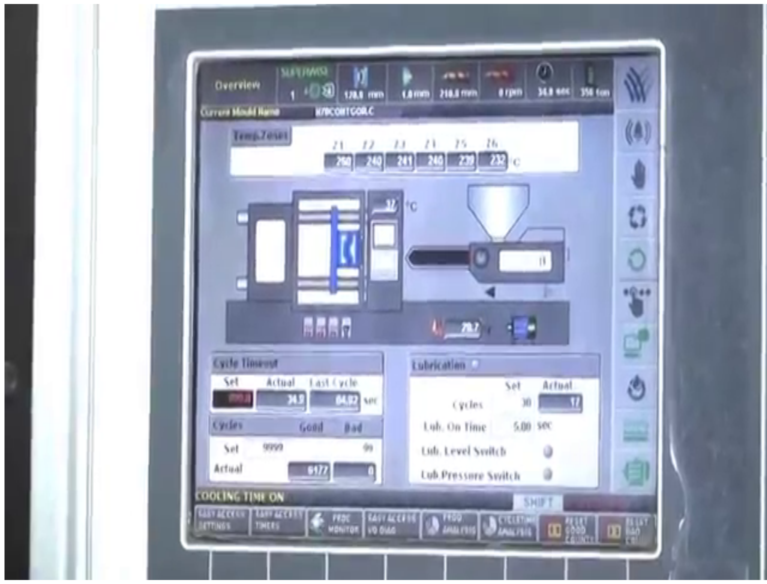

[FL] natural [FL] white [FL] color [FL], [FL] plastic material [FL] procure [FL], [FL] procure [FL] material [FL] [FL] casing [FL] battery [FL] casing. [FL] [FL] box [FL].

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[FL] material [FL] machine [FL] box; die[FL] gate [FL]die injection [FL] cooling time [FL] injection, [FL] refill temperature [FL] 240 [FL] process [FL] cooling [FL] mould open [FL] open [FL] mould open [FL] gate [FL] piece injection [FL].tonnage

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[FL] speed [FL], pressure [FL], position, [FL] time [FL] mould safety [FL] tonnage, [FL] tonnage [FL] [FL] injection [FL]. Injection moulding machine [FL]. [FL] cooling time [FL] cooling [FL] cooling [FL] mould [FL] dribbling [FL] injection [FL] function [FL] injection [FL] speed, pressure, position, time [FL] injection, [FL] step [FL]. [FL] 64.95 second [FL] Piece [FL] 48, 43, 47, 38 [FL] problem [FL] function [FL].

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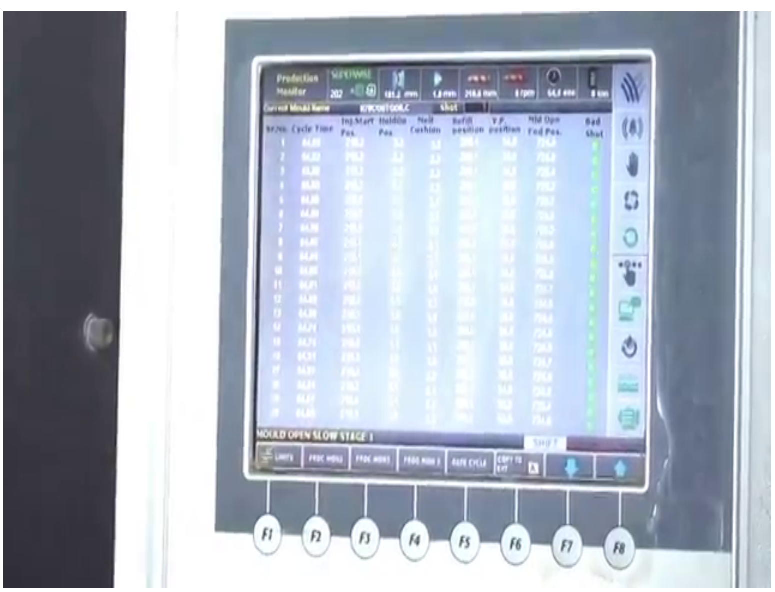

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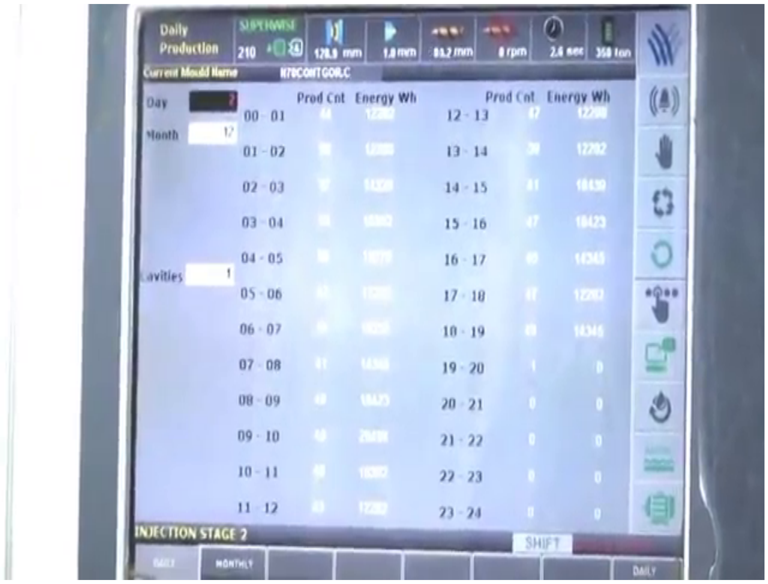

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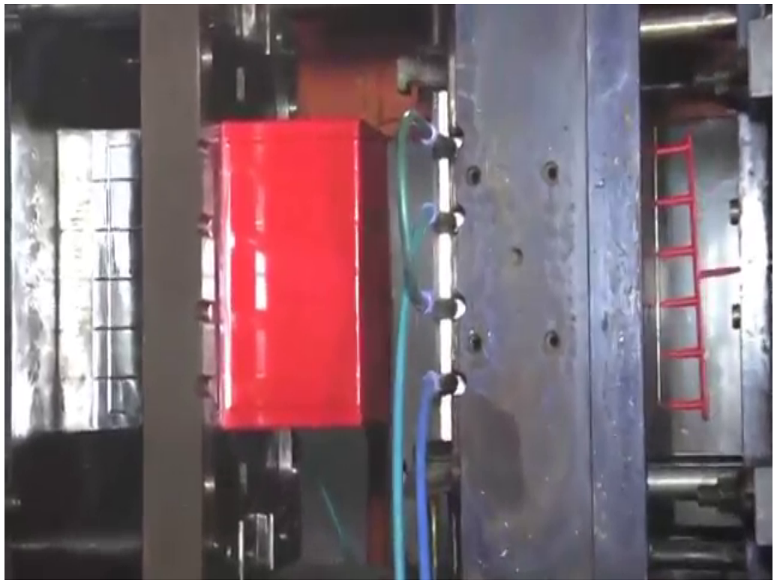

Color [FL] color [FL] color [FL] [color] mix [FL] color mix [FL] [mix] mixing [FL] piece [FL].

So, what you have just seen so far is basically a plastic container making machine which is an injection moulding machine. This machine is the sprint 358 model of the company Windsor which makes this machine. And so, in this machine what is happening is the raw materials are procured and they are put as input to this machine.

And this machine you know after you have set up all these different parameters through this PLC panel, based on the parameters that are set the machine basically takes those input raw materials and then based on the shape the cast and so on this machine basically prepares the final output the case that is required for the batteries. So, what is very important is to notice that it is a very precise job that has to be done. So, for precision there are number of sensors that are used in this machine and the similar ones. So, these sensors basically are very important in order to get the specific measurements that are required, because you know if you do not have accurate measurements that are done then what will happen is the final job is not going to be perfect as per the requirements.

So, essentially what we have is a cyber physical system which has number of different types of sensors these sensors basically capture the different measurements that are required. So, in this particular case one of the sensors is it, it basically senses the measurements in terms of how much length this particular you know this piston is going to move for. And based on that it is going to move for that much that much amount of distance and then what happens is this sensing based on the sensed data the actual operations are preformed and based on the actual operations the decisions are different.

You know different decisions that are made and then there is a feedback control that feeds the controller about you know what has to be done next This is not a perfect example of an industrial I O T or you know it is not really a machine which will get it to the requirements of industry 4.0 and as you have seen for industry 4.0. What is required are different components first of all inter information or data acquisition through the help of different sensors and so on which is already there , but after that the processing has to be done.

And based on the processing the different decisions has to be made and based on the decisions there is a feedback control that has to be sent back to the machine or elsewhere for further actions. So, this is one machine like this there are few other machines in this particular company and all of these machines could also be interconnected. So, interconnection as I told you earlier is a very important component of II O T and industry 4.0.

So, interconnection interconnectivity between these different machines and having all of them controlled through either centralized or a distributed mechanism or, or a combination of both is what is required. Additionally there are other important issues in industry 4.0 issues of basically maintenance, right. So, if there is some defect that has happened then how do you take care of it? So, let us say that in the products production process there is some defect that comes in. So, one way is to manually go and you know correct, correct whatever it has gone wrong the other thing could be that if you already have this automated system built in which will detect the error and then that will be detected the signals will be sent and the corrections are going to be made all autonomously then that is what is more desirable.

So, that will be a fully autonomous system. So, this is what is required. So, this is just to show how some of these industries are functioning and how a an industry which is not yet there for industry 4.0 compliance. How you can have different transformations, in these different machineries of these companies to make them more compliant with industry 4.0 requirements.

So, industry 4.0 requirements what is important is to have sensing actuation data processing decision making and feedback control. So, essentially these are some of these important components of a cyber physical system as well. So, what is also important the last component I would say what is important is the fault detection maintenance and automated detection and maintenance of faults is a very important component.

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So, let us see how these companies and others similar ones small or big ones how they transform themselves in the next few years towards industry 4.0 you know compliance. So, in the previous workshop floor what we have seen is basically how to make this which is essentially the casing for the battery. And this is a plastic based casing and through injection moulding process. As we have seen this particular case is made and so, this was done by a machine the machine you know which is the H sprint H 350 machine and another machine the sprint H 250 machine basically prepares the lid. So, this is the lid of the machine and there are other few similar kinds of machines that are here in this particular company which will make the other different plastic parts like the handle the screws that are there. So, this screw similar kinds of screws will also be made.

So, this screw basically gets in and so on. So, the entire plastic casing; that means, the bottom part as well as the top part the lid all of these are made in the different floor through the different workshop processes in this company. So, what I was talking about is the industry 4.0. So, industry 4.0, I have told you already that you need the different the interconnectivity between the different components of data acquisition through sensing processing then the feedback control and also the operator maintenance automation or of all of these things and so on but one of the very important things that I did not mentioned which is also very important is the interconnectivity. Interconnectivity within the machine and interconnectivity across the different machines..

So, for example, this part was made by one of the machines in another machine floor this is made by another machine in this particular machine floor and there are other parts that are made by other machines. So, would not it be very nice to have all of these different machines interconnected with one another.

So, essentially what happens is that when the bottom part is made after that the signals are sent to the next machine which will take the process over and automatically things are going to be started. So, all of these machines if they are all interconnected that is going to be the advantage you are going to reduce the down time and you are going to improve the overall productivity in the process and also consequently what is going to happen is the quality overall quality in terms of the product quality in terms of the processes the efficiency the productivity and the economic benefits all of these things are going to come through.

So, as you can see that in you know the when we will try to transition ourselves to industry 4.0, you know then what is going to happen is we are going to gradually, gradually we are going to acquire all these different benefits into the processes. And hopefully these industry this one and many other similar industry who are maybe they are small in size now, but very progressive minded what is going happen probably is in the years to come maybe in another ten years or.

So, you know once they all are going to be industry 4.0 compliant all of these automation that I told you the interconnectivity between the different machines the automation the collection of all these data, data from these individual different machines and putting them all together to have better inferencing and so on. So, all of these things are going to be come in come in place and there is going to be the improved productivity.

So, this is just a case study to show you how the machines which are not the industries which are not yet there how they can transform themselves into to make them industry 4.0 compliant.

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So, right now we are in another type of company which is basically a company which focuses on taking raw plastic materials and then converting them into plastic bottles. So, behind me is a machine a smart machine which is used for making these plastic bottles, it is known as the single state blow moulding machine. And this particular machine as you will see what it does is it takes the raw plastic materials and based on the program that is stored in this machine basically then that program the instructions are taken and the, the plastic bottles are made.

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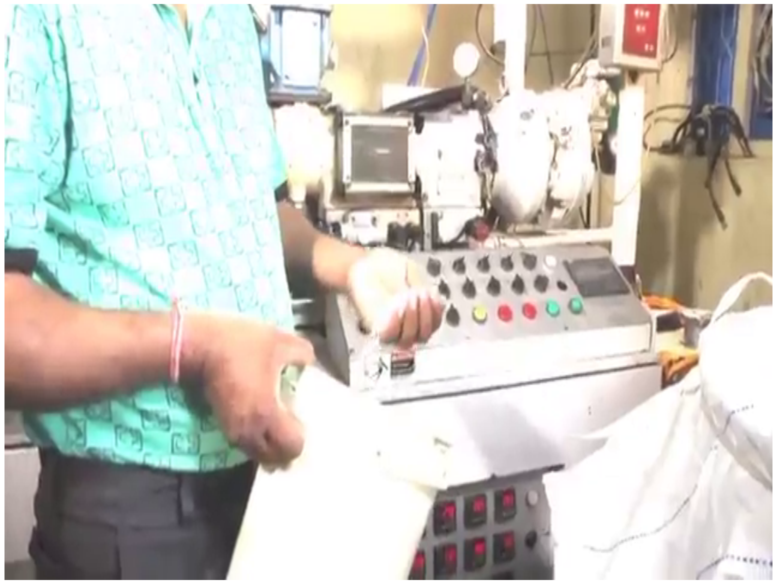

So, this is an intelligent machine where you can do the programming using the man machine interface the M M I interface which is there and through the instructions that are basically programmed through the M M I. The, the instructions are taken through the P L C which is in this particular machine the programmable logic controller which is there. So, if it is which takes those instructions and those instructions are passed to the machine for taking the corresponding actions. So, this is one such machine which could be used to make the factory floors smart. So, you can have smart factories, but as you can understand that this is one machine like this there could be several, several other different types of machines.

So, if you are talking about a smart factory floor the interconnection between all these different machines is very important. So, that these machines you can do the monitoring of all the machines the health monitoring of all the different machines the type of the operational efficiency also could be monitored. So, like this different, different types of monitoring could be done the data the data that is coming from these machines these could also be stored and different predictive and operational efficiency could be the predictions can be made.

So, lot of different things could be done, but you know at this point what this machine does is intelligently. It takes the commands and then comes from the raw materials into plastic bottles. So, let us have a look at how this particular machine functions.

[FL] material [FL] polyethylene terephthalate [FL] bottle pharmaceutical, pharmaceutical packed bottle [FL] produce [FL] process, [FL] a material fully hydroscopic material [FL], atmosphere [FL] moisture [FL], material [FL] moisture [FL] remove [FL] material [FL] drum [FL] load [FL], drum [FL] material auto loading system [FL] hopper, [FL] hopper [FL] 150 degree temperature set [FL].

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Temperature [FL] material [FL] moisture [FL], hopper [FL] material [FL] barrel [FL] machine [FL] related [FL].

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Barrel [FL] movacolor dosing unit [FL] color [FL] bottle [FL] produce [FL] (Refer Time: 18:57) [FL] through [FL] barrel [FL] barrel [FL].

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Barrel [FL] 250 degree [FL] material [FL], material melted material [FL] H R block [FL] die [FL] mould [FL] preform [FL] preform [FL] blow mould [FL] machine [FL] process [FL] automatic [FL].

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Blow mould [FL] preform [FL] 180 degree [FL], preform [FL] bar [FL] pressure [FL] blow [FL] mould [FL], article [FL] shape [FL] mould [FL] article [FL] eject, [FL] M M I [FL] parameter load [FL] machine [FL].

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Bottle [FL] parameter [FL] M M I [FL] through machine [FL] P L C [FL] Program [FL] machine run, [FL] Mitsubishi [FL] P L C [FL].

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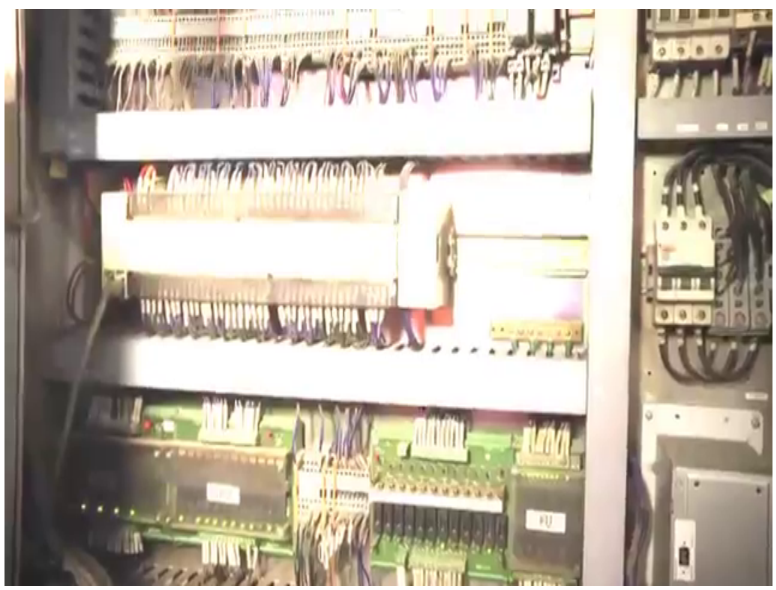

P L C [FL] machine [FL] M M I [FL] program [FL] run [FL] temperature controller [FL] temperature controller bottle [FL] shape [FL].

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Melting [FL] barrel [FL] temperature [FL] left [FL] 250 to [FL] 280 degree temperature [FL] material [FL] melt [FL] process [FL] mould, [FL] mould [FL] H R block [FL] die [FL] nomenclature [FL] H R block [FL], H R block [FL] punch [FL] punch [FL] cavity [FL] punch [FL] cavity [FL].

Punch [FL] cavity [FL] preform [FL] shape [FL] preform [FL] blow cell [FL] punch [FL] cavity [FL] upper mould [FL] lower mould [FL] sensor [FL] through run [FL], sensor [FL] sensor [FL] proximity sheets [FL] upper mould [FL] lower mould [FL] slow down [FL] fast open [FL] program [FL] P L C [FL] sense [FL] P L C [FL] (Refer Time:21:27) [FL] preform rotate [FL] blow mould [FL] lip cavity [FL] lip cavity [FL] rotate [FL] lip cavity [FL] lip cavity part [FL] blow mould [FL] blow core [FL] blow core [FL] pipe [FL] bar [FL] pressure preform [FL] blow [FL] preform article [FL] shape [FL] preform [FL] blow mould open [FL] blow mould [FL] article [FL] shape [FL] shape [FL] out [FL] part [FL] lip cavity [FL] blow mould [FL] sensor [FL] sensor [FL] sensor [FL] blow mould [FL] sensor [FL] blow mould [FL] sensor [FL] sensor [FL] P L C [FL] command [FL] close [FL] blow core [FL] open [FL] lower mould [FL] rotate [FL] preform [FL] cycle [FL] proximity sensor [FL] P L C [FL].

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