PIC Based Power Loom Automation Using IOT

P.Balasubramani, R.Krishnaveni

Abstract: In this paper, a novel method to automate shuttled power looms is proposed. Power loom is a mechanized loom, mainly meant for the purpose of weaving in textile industries. It considerably reduces human labor and wastage. Hence it helps to ensure high quality cloth production, monitoring and measurement. It provides automatic warp and weft error detection and automatic weft replenishment. This module uses PIC16F877A to provide the necessary automation of the shuttled power looms, with immediate termination of its motor operation in case of any weft or warp errors. Also the amount of woven cloth is ultimately displayed in LCD.

Keywords: weft, warp, single and double pick, PIC16F877A Proximity sensor, Control switches, Phototransistor, error detection and indication, production monitoring.

I. INTRODUCTION

Power loom is a mechanized loom used for weaving yarns in textile industry. It uses a drive shaft for power and became a key development in industrialization of textile industry during early industrial revolution. Invented by Edmund Cartwright in Great Britain, in 1784, power looms made the process of weaving and creating textiles much quicker than with the hand driven looms. This made the power loom to become one of the defining machines in the industrial revolution. This tool was further refined after 47 years by Ken worthy and Bullough, a design which was partially automatic. In 1895, many looms driven by electric engine were invented and in the beginning of 1930s, each individual machine was driven by an electric motor. There are two types of power looms: shuttle and shuttleless power looms. In this paper, automation of shuttled power loom is proposed. The terms warp and weft are two key terms used in the process of weaving. In literal sense, they are the technical terms for the two types of thread used to weave a cloth. The warp is the tightly stretched lengthwise core of fabric, while the weft is woven between the warp threads to create various patterns. Sometimes weft is also called as the ‘filler’ thread, since it fills in the desired design and also as ‘woof’in some regions. The huge components of the loom are the warp beam, heddles, harnesses, shuttle, reed and take-up roll. In the loom, yarn processing includes shedding, picking, battening and taking-up operations. Shedding is the process of raising the warp yarns to form a loop, through the weft yarns. In modern looms, shedding process is carried out by heddle frame. In picking, the filling yarn is inserted through the shed by a shuttle (a yarn carrying device). A single crossing of the shuttle from one side of the loom to the other is called as single pick and the second crossing to is original position is called as double pick. In the process of battening, shuttle also moves through a frame called reed as it moves across the loom lying down the fill yarn. Conventional shuttle looms can operate at a speed of about 150 to 160 picks per minute. The newly woven textile is rolled up on a beam. This process is called as taking up. To become fully automatic, loom requires immediate stop motion if any warp or weft yarns break.

II. EXISTING SYSTEM

The existing system for the automation of the power looms, was established many years ago. This system, though, it has many advantages, it suffers from serious drawbacks also. In this, IC 555 timer is used to control the entire automation of such a huge mechanized looms. In this system, IC 555 timer provides the necessary automation. The warp and weft errors are detected and multiplexed to a signal generator, whose output is given to the timer IC. Since IC 555 has only a single input, multiplexing multiple inputs become a tedious job. Also this system has a status indicating unit, comprising of three LEDs (green, red, and yellow). The block diagram of existing model is given in figure 1. The weft error detection is made possible by using an electro-magnetic setup. This mechanism fails to stop the loom immediately since it takes a few durations for the coil to become an electro-magnet and so the shuttle takes a certain number of picks, even if the weft yarn is broken. As a result, damaged fabric gets woven. In this system, MOC7811 is used. It is a position Encoder sensor, which is used to find position of the wheel. It consists of IR LED and photodiode mounted facing each other enclosed in plastic body. When light emitted by the IR LED is blocked because of alternating slots of the encoder disc logic level of the photo diode changes. This change in the logic level can be sensed by the microcontroller and give as the output to controller. This sensor is used to give position feedback of the loom. This model suffers from serious disadvantages. Weft yarn replenishment is absent. This system detects weft errors. But it does not have accurate and precise control of weft yarns. It also fails to facilitate production monitoring, measuring and displaying the quantity of woven fabric in any display devices.
Since timer IC has only a single input, multiplexing multiple inputs using proper selection controls increases system complexity. Hence, hardware implementation is very complex and time consuming. Above all, this system is less reliable and accurate, as immediate seizing of loom operation is not possible.

III. PROPOSED MODEL

In this paper, a PIC based automation circuit for shuttle looms, that facilitates automatic weft and warp stop motion is proposed. Also it provides automatic weft replenishment and has a warning system. It is a cost efficient and an intelligent system for automating the shuttle looms. This has tremendously decreased the required man power and also ensures high quality woven fabric.

A. Power supply unit

For the functioning of any components, a power supply is the most basic requirement. In this module, 5V power supply is used.

B. Microcontroller unit (PIC 16F877A)

Peripheral Interface Controller or Programmable Interrupt Controller a family of modified Harvard architecture microcontrollers made by Microchip Technology. It is a 40 pin IC and has an inbuilt 10 bit, 8 channel analog to digital converter. It exhibits high performance RISC CPU, only with 35 instructions. All single cycle instructions except for branches, which are two cycles. It has an operating speed of: DC-20 MHz clock input and DC-200 nanoseconds instruction cycle. It has a FLASH program memory of 8K x 14 words, up to 368 x 8 bytes of Data Memory (RAM) and up to 256 x 8 bytes of EEPROM Data Memory. It has many other advantages like self-reprogrammable under software control, In-Circuit Serial Programming™ (ICSP™) via two pins, single-supply 5V, in-Circuit Serial Programming, programmable code protection and power saving sleep mode.

C. Warp error control unit

The major function of warp error control unit is to stop the loom when any of the warp thread breaks. This module consists of a long metal rod and numerous v shaped needles. Basically 4000 warp yarns are wounded over the roller beam. Each thread is provided with a metal needle just above them. The metal rod is placed beneath the group of warp yarns. The metal rod is separated into two by an insulator, one part is given a positive charge and other as negative. If any of the thread breaks during the process of weaving, the metal needle, placed just above the yarn falls over the rod, thus completing the electrical circuit. This error is constantly monitored and sensed. This type of error is called warp error and if such an error is sensed, the operation of loom is seized immediately. It is illustrated in fig.2.c.
D. Weft error control unit
The weft error control unit is used to stop the loom when weft yarn breaks. This module makes use of inductive proximity sensor. An inductive proximity sensor is a type of non-contact electronic proximity sensor that is used to detect the position of metal objects. The sensing range of an inductive switch is dependent on the type of metal being detected. Ferrous metals, such as iron and steel, allow for a longer sensing range, while nonferrous metals, such as aluminum and copper, can reduce the sensing range by up to 60 percent. In conventional looms, a shuttle weighing around a half a kilogram is inserted through the warp shed to facilitate weaving. This shuttle carries the weft yarns. The weft thread is provided with a metal rod like structure. Each time a weft thread makes a single pick, it uplifts this rod and makes alternate sensor contacts. If the weft thread breaks or cut, then sensor output is continuous 1s, which in turn indicates that the loom has to be stopped immediately.

E. Weft replenishment unit
Weft yarn is bundled in a shuttle, which is approximately half a kilogram heavy. During each single pick, the weft yarn weaves in between the warp yarns in order to make the woven cloth. Unlike warp threads which are kept under high tension on the loom, the weft is not kept under the same amount of tension and therefore does not have to be constructed out of as strong of a yarn as the warp threads. This module uses a combination of IR LED and photo transistor. An IR led is placed above the weft shuttle and phototransistor below it. Initially when the shuttle is fully bundled with the weft threads, no light falls on the photo transistor. As the yarn goes on decreasing, the intensity of light falling on phototransistor goes on increasing. When the weft yarn is completely used up, the intensity of light falling on the phototransistor is maximum. The motor is stopped at the nearest maximum intensity, i.e. before the yarn gets completely used up. This module is interfaced to the ADC channel of the microcontroller in fig.2.d

F. Production monitoring and display unit
In any commercial industries, the quality and quantity of finished products are very important, especially in textile industries. The primary aim of any commercial textile industry is to produce maximum amount of undamaged fabric. But manual measurement of the fabric woven by each power loom, is tedious. This module, proposed here, provides constant measurement of woven cloth and the same is displayed in a liquid crystal display. This module makes use of inductive proximity sensor for measuring the woven fabric and the resulting value is displayed in the LCD. The proximity sensor, as it is capable of detecting metals, is placed in contact with the warp roller beam. During the process of weaving, the roller moves here and forth. This number of moves made by the roller, in turn gives the quantity of woven fabric. In order to sense the number of movements made by the roller beam, an inductive proximity sensor is used. This number is then converted into the quantity of woven fabric and ultimately displayed in the LCD.

G. Control switches and status indication unit
A switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another. There are three push buttons used in this system. They are Start, Stop and Pick. Start button is used to start the operation of the loom, i.e. to start the motor initially. As the name indicates the stop button is used to seize the running of the motor, i.e. to terminate the operation of the loom. The pick button plays an important role in weaving. If only a small portion of the fabric has to be weaved with a different color, say borders of sarees and dhotis, the pick button can be used. This button operates the loom for a discrete amount of time and stop the loom by itself. Status indication unit comprises of LEDs and a buzzer, which are used to indicate the working status of loom. When the Start button is pressed, the motor starts running, which is indicated by the glowing of Green LED. When the motor is stopped either by the Stop button or due to any weft or warp error, the Red colored LED starts glowing and an alarm sound is given by the buzzer. The Yellow colored LED gets lighted up during the picking process, i.e. when the motor is going to seize its operation.

H. Relay and Motor Unit
Relay and motor unit is responsible for the smooth working of power loom machines. Rather they are solely responsible for
the operation of power looms. In real time applications, 1 HP 3 phase motors with 1440 and 960 RPM are used. Here in this prototype module, 12V relay and 12V DC gear motor are used. The circuit diagram of the model is described in the fig.3.

![Circuit diagram of PIC based automation of shuttled power looms](image)

**Fig 3.** Circuit diagram of PIC based automation of shuttled power looms

The same is simulated using MPLAB IDE. MPLAB IDE supports multiple debugging tools in a single development paradigm, from the cost effective simulators, through low cost in-circuit debuggers, to full-featured emulators. This eliminates the learning curve when upgrading to tools with increasing flexibility and power. The MPLAB IDE allows to:

- Edit your source files (either assembly or C)
- One touch assembles (or compile) and download to PIC micro emulator.
- Easy debugging

![Simulation output](image)

**Fig 4.** Simulation output

Figure 3 shows the defect in the weft thread. In the simulation the defect is shown such that when weft thread is cut, the LCD shows the status as weft detected and machine stop.

### IV CONCLUSION AND FUTURE WORK

In this paper, we proposed a method for automatic warp and weft error detection and automatic weft replenishment and provide the necessary automation of the shuttled power looms, with immediate termination of its motor operation in case of any weft or warp errors monitoring the power loom functions automatically with the help of IoT. In future, manual assistance in beam replacement and warp breaks can be automated and multi looms can be controlled by use of Solitary controller.

### References