



ELECTRONIC CHIN UP EQUIPMENT

Patent Application Document

Technical Description

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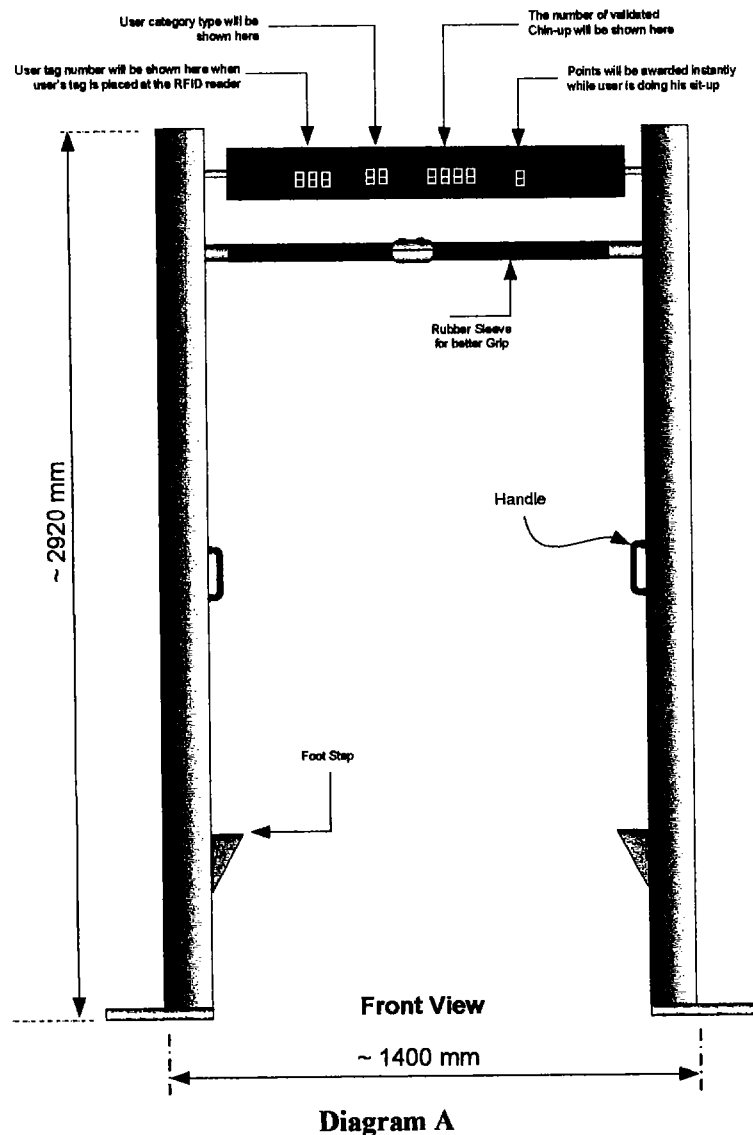
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Electronic Chin Up Equipment

1.1 Functional Description

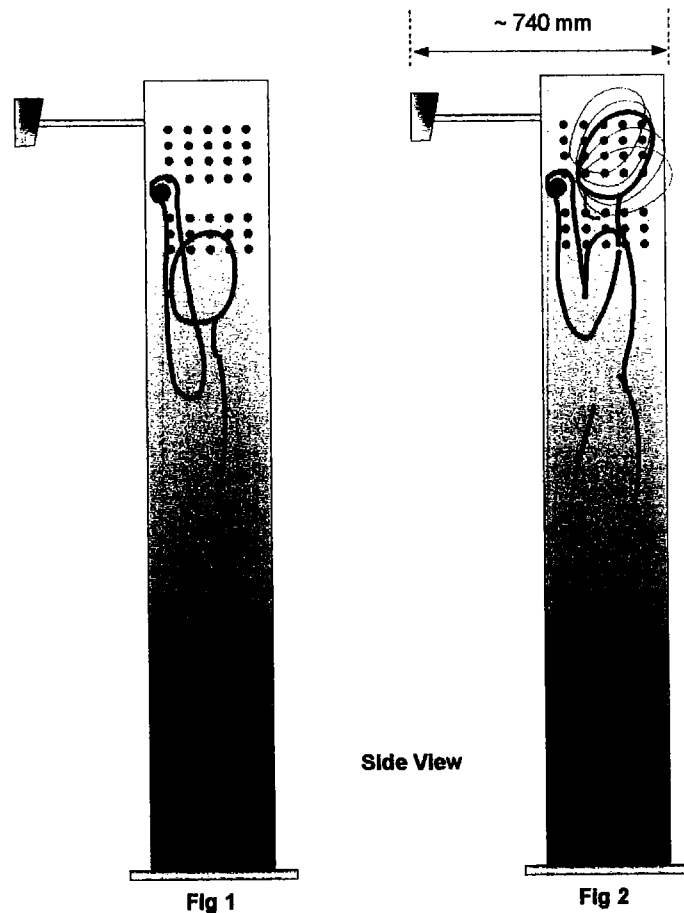
The Electronic Chin Up Equipment is designed to function as test station – to electronically VERIFY and COUNT the number of valid chin-up performed by the user. Diagram A shows the user interface comprises of LED display panel. As part of an input device, a RFID¹ reader is installed on the side of the equipment (not shown in diagram).



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As depicted in Fig 1 and 2, the machine is installed with two sets of infrared sensors arranged in matrix and are installed at the upper side of the chin-up wall.



1. Radio Frequency Identification

To start using the equipment, the user is expected to scan his (pre-issued) RFID Tag at the RFID reader. The memory chip within the RFID tag contains his particulars including his tag number, category type (age group) and other relevant data. The system will read the data from the Tag and display his Tag number and other particulars. The user can then start doing his chin-up at his own time. For each validated chin-up performed, the system will increment the score by '1' digit count with a corresponding voice count. The Score (the number of successful chin-up performed) and the corresponding points awarded will be displayed at the LED screen for the user to view.



Once user releases his grip totally and landed on the floor, the system detect as test finished and the resulting score and points will be automatically written into the memory of the RFID Tag², The result may also transmit to any server via wired or wireless LAN if desire.

RFID Tag²: Smart RFID card are commonly used in many application such as building access control, public transport fare. They offer many options in term of personalization.

1.2 Profiling

The Chin Up Equipment is programmed to validate the following profiles:-

Valid Profile (Count)

1. User first hang from the chin-up bar with his arm straightened and then pull up until chin above bar.

Invalid Profile (No Count)

1. User first hang from the chin up bar with arm straightened and then pull up BUT his chin failed to go above the bar.
2. User failed to straighten arm before pulling up for his next chin-up.

1.3 Detection Algorithm

The program expects the first few chin-ups attempt by the user will meet the defined standard. Taking the first three chin-up as reference (the number of reference is user definable), the subsequent chin-ups are measured and validate against the standard of these first three chin-ups.

As described above, there are two set of infra red sensors matrix, one set (M1) is installed above the chin-up bar and the other (M2) is installed below the chin up bar. M1 is programmed to detect chin-above bar profile and M2 is programmed to detect arm straighten profile.

1.3.1 Hand-Straighten Detection

Basically there is no simple and direct way of measuring whether the hand is straightened or not. The head is the only relative body explicitly enough to determine the arm straightens profile. How is it done? The M2 sensors is installed below the chin-up bar and arranged in a form of 3 by 5 matrix, comprises of 15 sensors ranging from r1c1 to r3c5 as shown in Fig 1.3.1A

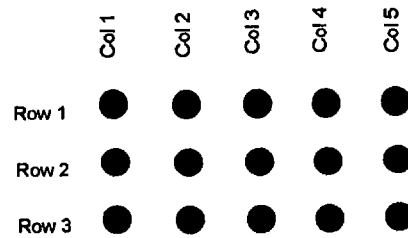


Fig 1.3.1A

When the user first hang on the bar with his arm straightened, his head would probably block some sensors of certain rows or columns. In our case of Fig 1.3.1B, some sensors in row 3 and 2 are blocked, namely [r3c2, r3c3, r3c4, r2c3]. Correspondingly all other the sensors within row 1 are cleared, so we used row 1 as one of the parameters to determine his arm straighten profile. If the arms are not straightened during subsequent chin up attempts – some sensors in row 1 would probably be blocked, hence there will be a NO COUNT state, even if the user's chin is above bar during the next consecutive pull up.

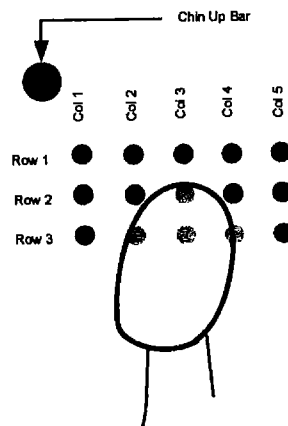


Fig 1.3.1B

Depending on the demand, the sensor matrix can be sized up with more sensors to increase the resolution and widen the coverage for different 'arms length' (head size).. i.e more rows to cover different arms length and more

columns to cover different horizontal movement of the head. Generally, the higher the number of sensors (row x column), will offer a better measurement in term of its resolution and precision.

1.3.2 Chin-Above-Bar Detection

The M1 sensors are installed above the chin up bar and similarly arranged in a form of 4 by 5 matrix comprises of 20 sensors ranging from r1c1 to r4c5 as shown in Fig 1.3.2A.

	Col 1	Col 2	Col 3	Col 4	Col 5
Row 1	●	●	●	●	●
Row 2	●	●	●	●	●
Row 3	●	●	●	●	●
Row 4	●	●	●	●	●

Fig 1.3.2A

At first few chin ups $[1 + n]$ (where n is user definable) some of the sensors in M1 will be blocked as shown in Fig 1.3.2B. The sensor matrix M1 is fitted such that row1 and column1 are identified as *sure-clear* sensors. That is to say if any of the sensors within the *sure-clear* 'zone' is/are blocked, the profiling program will register as COUNT. This is so because of the following assumptions:-

1. it is generally not possible that sensors within column 1 can be blocked without the chin going above the bar.
2. the position of row 1 sensors is fitted in such a way that it cover all head sizes. The head size is measured across the tip of chin to tip of head-top.

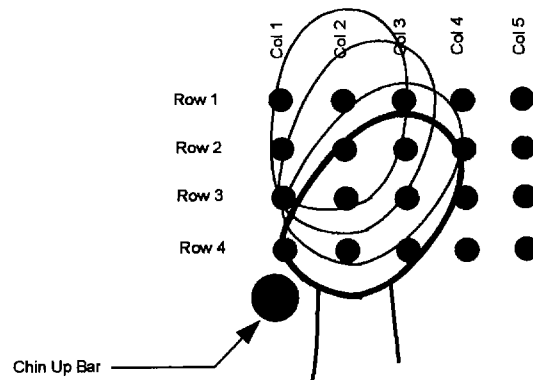


Fig 1.3.2B

The challenges of the chin-above-bar detection algorithm is trying to detect the profile where the head is in tilt-back position, where none of the *sure-clear* sensors are blocked and yet his chin is ABOVE bar. To detect this unique profile, the following methodology is used.

As depicted in Fig 1.3.2C, the sensor matrix M1 is arranged in such a way that the following group of sensors must be blocked simultaneously to equate a COUNT: -

1. *any 1 or more of the sensors out of [r4c5, r3c5, r2c5] AND*
2. *any 1 or more of the sensors out of [r3c2, r3c3, r3c4, r2c2, r2c3, r2c4] AND*
3. *any 1 or more of the sensor out of [r4c2, r3c2, r2c2]*

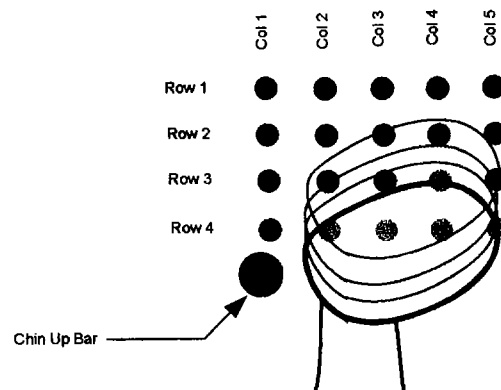


Fig 1.3.2C



Depending on the demand, the sensor matrix can be sized up with more sensors to increase the resolution and widen the coverage of different head sizes.

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