Systematic Functions and Switch Functions in Taxi Meter
ระบบการทำงานและหน้าที่การทำงานของสวิทช์ในแท็กซี่มิเตอร์

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Abstract

The article was to study the systematic functions and the switch functions in taxi meter including the memory data displays. It showed the systematic diagram for a better comprehension, such as the display board, CPU board, Input /Output driver board and also showing a transducer and a battery connection including the signal lamps for passengers. Moreover, it explained all working steps of taxi meter including the setting value of switches to fit to any vehicles which were the guidelines for commercial researches. The article did not explain about the rate change when the transportation authority allowed changing the fare rates, but it will be written after a research on commercial taxi meter is finished. This article would suggest the ideas for further design as a commercial taxi meter, and hopefully it would be beneficial to interested persons, electronic engineering students on using these ideas for further researches.

Keywords: taxi meter, innovation designing

บทคัดย่อ

บทความนี้ เพื่อศึกษาระบบ และหน้าที่การทำงานของสวิทช์ในแท็กซี่มิเตอร์ ซึ่งจะบอกรายละเอียดขั้นพื้นฐานและหน้าที่การทำงานของสวิทช์ต่าง ๆ รวมทั้งการแสดงผลของข้อมูลที่เก็บไว้ในหน่วยความจำ ผู้เขียนได้นำเสนอไดอะแกรมทั้งระบบเพื่อความเข้าใจระบบการทำงานของแท็กซี่มิเตอร์ให้ง่ายขึ้น มีการแสดงบอร์ดแสดงผล บอร์ดซีพียู บอร์ดอินพุตเอ้าพุตไดรเวอร์ อีกทั้งแสดงการต่อสายข้อมูลจากทรานดิวส์เซอร์ แหล่งจ่ายไฟและไฟบอกสัญญาณแก่ผู้โดยสาร นอกจากนี้ยังอธิบายถึงการทำงานทุกขั้นตอนที่จำเป็นของแท็กซี่มิเตอร์ รวมทั้งการตั้งค่าต่างๆเพื่อให้เข้ากับรถแท็กซี่ทุกรุ่นที่มีอยู่ในปัจจุบัน เพื่อเป็นแนวทางในการทำวิจัยในการออกแบบฮาร์ดแวร์และซอร์ฟแวร์ของแท็กซี่มิเตอร์ แต่ทั้งนี้ยังขาดการ

เปลี่ยนค่าโดยสารใหม่เมื่อมีการเปลี่ยนระบบการคิดเงินจากกรมการขนส่งทางบก ซึ่งผู้เขียนจะอธิบายภายหลังเมื่อทำวิจัยเชิงพาณิชย์สำเร็จในเร็ววัน บทความนี้สามารถนำไปต่อยอดในการออกแบบแท็กซี่มิเตอร์เชิงพาณิชย์ ผู้เขียนหวังเป็นอย่างยิ่งว่าจะเป็นประโยชน์ต่อผู้ที่สนใจ นักเรียนนักศึกษาด้านไฟฟ้าอิเล็กทรอนิกส์จะนำไปศึกษาและทำการวิจัยต่อยอดต่อไป

คำสำคัญ: แท็กซี่มิเตอร์, การออกแบบนวัตกรรม

1. INTRODUCTION

Thailand 4.0 is an economic model that aims to unlock the country from several economic challenges resulting from past economic development models which place an emphasis on agriculture (Thailand 1.0), light industry (Thailand 2.0), and advanced industry (Thailand 3.0). These challenges include “a middle income trap”, “an inequality trap”, and “an imbalanced trap”. In order to transform Thailand’s comparative advantage through knowledge, technology, and innovation, a long term goal to develop. The 5 technology and target industries will be transformed into “integrated research” in order to provide possible solutions to challenges that may arise at the national and global levels, as well as identity business opportunities for the private sectors [1]. The TAXI METER is the one and is the new generation of electronic taximeters, incorporating advanced technology and design, specifically to meet the ever changing needs of the taxi industry. The heart of the TAXI METER is a new state-of-the-art proven computer which performs all the necessary functions and computations. A number of unique features have been integrated into the system to produce maximum efficiency in operations as well as easing of use to the users. The following features of the TAXI METER illustrate the design philosophy engaged to produce this revolutionary meter: The TAXI METER consists of 3 printed circuit boards that are fully interlocked eliminating messy wire looms completely. The only “loose” wires are those to external lamps. Thus reliability is tremendously improved. Each of the 3 printed circuit boards is fully modular and this facilitates servicing and fault finding, thereby saving time. Leading zero suppression has been included to eliminate unwanted 0’s (zeroes) after the most significant digit to produce an appealing display. E.g. TB 003.50 becomes TB 3.50. Distinctive LED (light emitting diodes) mode indicators show explicitly that switch entries have been accepted and also enables various functions to be used easily. Automatic light level control is to vary the display brightness according to ambient light conditions. The facility to total the extras to the

main fare and also permits the totaled fare to be reverted to fare & extras separately. In addition, if the driver forgets to place the TAXI METER back to HIRED mode (where applicable), the TAXI METER will automatically do so! An accurate (resolution to $1/8^{th}$ of a rev.) in-built digital rev. counter is to simplify the calibration process and reduce time for rate changes. Logically structured format is used for keyboard operation and an ergonomically designed front face. Separate PROMs for control and rates thereby enhancing the reliability factor, whenever there is a rate change. The hardware is so designed to allow easy implementation & realization of deferred options or requirements. The systematic diagram for taxi meter is shown in figure 1

2. THE SYSTEMATIC FUNCTIONS FOR COMMERCIAL TAXI METER [2], [3]

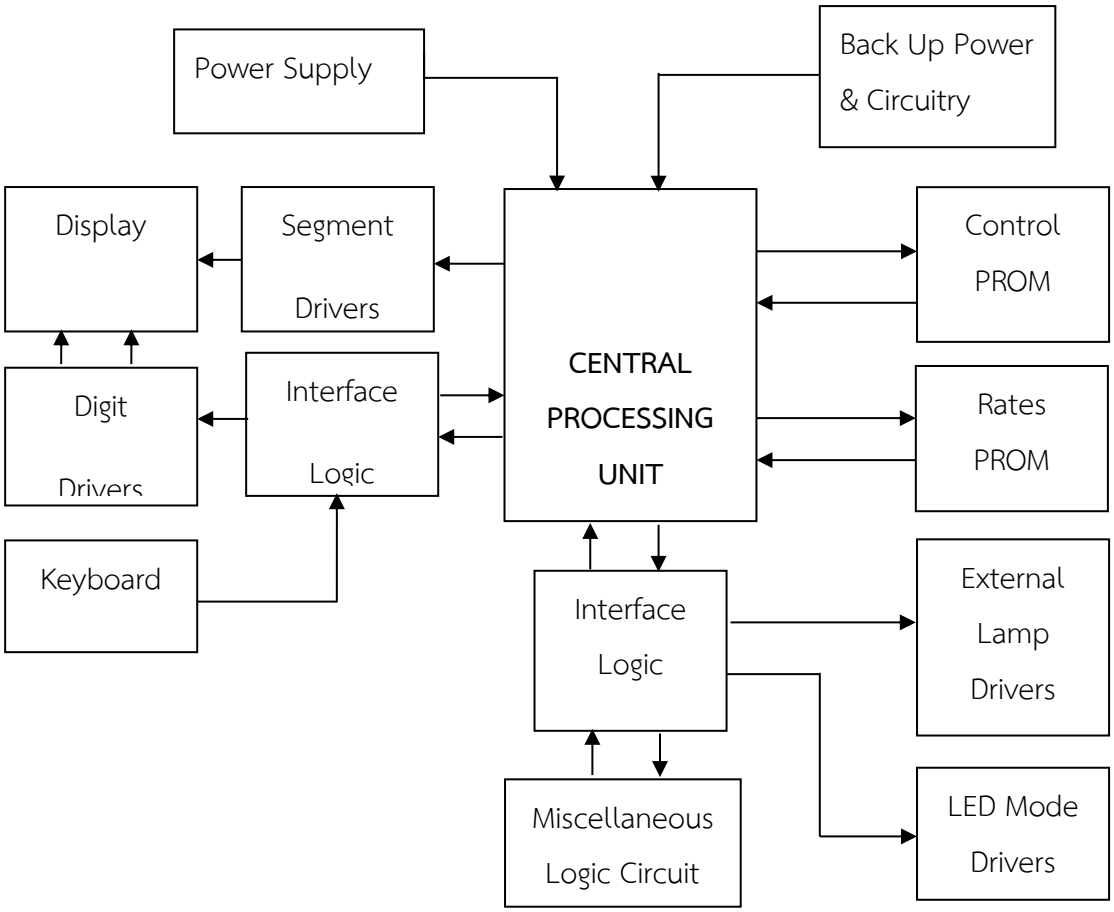


Figure 1: Systematic function

3. FRONT PANEL & SWITCHES FUNCTIONS FOR COMMERCIAL TAXI METER

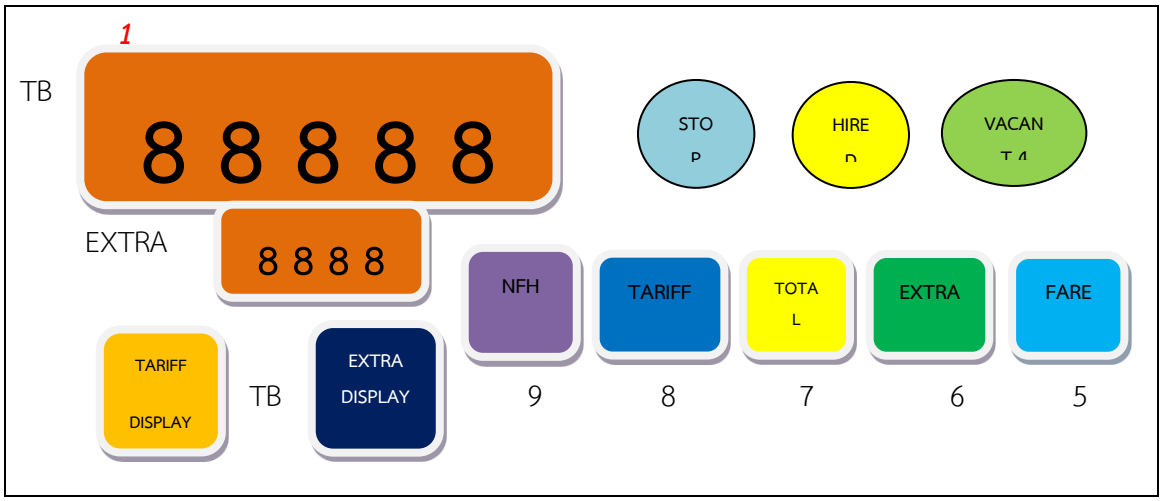


Figure 2: Taxi Meter front panel (2X)

4. LAYOUT & FUNCTION OF TAXI METER

1. FARE DISPLAY = In HIRED & STOP mode, displays the FARE
   = In MEMORY mode, displays the information in memory
2. STOP LED = Indicates DISTANCE ON, TIME OFF
3. HIRED LED = Indicates DISTANCE ON, TIME ON
4. VACANT LED = Indicates VACANT mode
5. FARE SWITCH = See tabulated chart for functions
6. EXTRAS SWITCH = See tabulated chart for functions
7. TOTAL / MEM SW.= See tabulated chart for functions
8. TARIFF SWITCH = See tabulated chart for functions
9. NFH / VAC = See tabulated chart for functions
10. EXTRA DISPLAY = Displays the appropriate EXTRAS
11. TARIFF DISPLAY = In HIRED & STOP mode, displays the TARIFF
    = In VAC mode, if TARIFF SW. keyed, displays TARIFF
    = In VAC mode, if MEM. SW. keyed, displays memory function number.

To understand more about the functions of switches in various modes, please see Table 1.

5. TABULATION OF SWITCH FUNCTIONS IN VARIOUS MODES [4]

	MODE			
SWITCH	NFH	VAC	HIRED	STOP
NFH / VAC	Toggles between NFH & VAC	Toggles between VAC & NFH	Reverts to VAC	Reverts to VAC
EXTRA	Inoperative	Proceeds to HIRED & loads flag fall. Time & Dist. active	Proceeds to STOP. Time is inactive. Dist. active	Reverts to HIRED. Time & Dist. active
TOTAL / MEM	Inoperative	Dsp. Infor'n stored in memory	Adds Extras to Fare dsp.	Splits Fare dsp. To Fare & Extras.
TARIFF	Inoperative	Selects Tariff	Inoperative	Inoperative

Table 1: switch functions

KEY : NFH = Not For Hire

VAC = Vacant

Dsp = Display

Infor'n = Information

NB. NFH mode = Time & Distance OFF

VAC mode = Time & Distance OFF

HIRED mode = Time & Distance ON

STOP mode = Time OF & Distance ON

The information stored in memory (numerical order) is as follows:

1. Total Money
2. Total Money of Tariff 2
3. Total Extras
4. Paid Kilometers
5. Total Kilometers
6. Trips
7. Units
8. Revset (current rev. setting of vehicle)

9. Rev. counter (used for calibration purposes)

N.B.

a. For switches NFH/VAC & TOTAL / MEM , TWO key depressions may be needed to accomplish a function depending on the current & previous mode. This feature serves the purpose of preventing accidental or unintentional key / switch entries.

b. For functions 4 to 9 , inclusive,

ignore the decimal point.

10. The display of information stored in memory is shown in Table 2.

6. TYPICAL DISPLAY FORMATS WHEN CYCLING THROUGH MEMORY FUNCTIONS

Memory Function :	**Display Examples :**
1. = Total Money	TB 35.00 TB 958.00
2. = Total Money Tariff 2	TB 89.00 TB 267.00
3. = Total of Extras	TB 166.00 TB 700.00
4. = Paid kilometers	TB 450.53 means 45053 Km. TB 61.19 means 6119 Km.
5. = Total kilometers	TB 666.88 means 66688 Km. TB122.97 means 12297 Km.
6. Trips	TB 77.64 means 7764 trips TB 846.28 means 84628 trips
7. Units	TB 555.17 means 55517 units TB 999.36 means 99936 units
8. Revset	TB 6.34 means 634 Revs. TB 5.99 means 599 Revs.
NB. The figures displayed when Revset is selected imply that the vehicle is set to ?.?? revs / km.	
9. Rev counter In general, the display format =	TB 614.03 means 614 & 3/8 revs. TB 701.07 means 701 & 7/8 revs. TB 658.00 means 658 revs. TB EDC.BA

Table 6: display format

Where the digits: EDC = whole/ complete revolutions

B = Redundant digit. i.e. ignore/always 0

A = 1/8 revolution counter

Therefore if digit A = 1 means 1/8 of a rev.

A = 2 means 2/8 of a rev.

A = 3 means 3/8 of a rev. Etc.

A= 7 means 7/8 of a rev.

7. THE EXPLODED VIEW OF TAXI METER

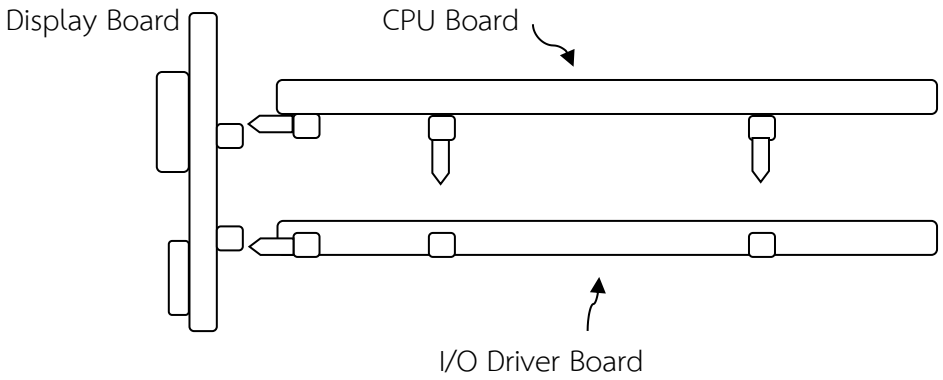
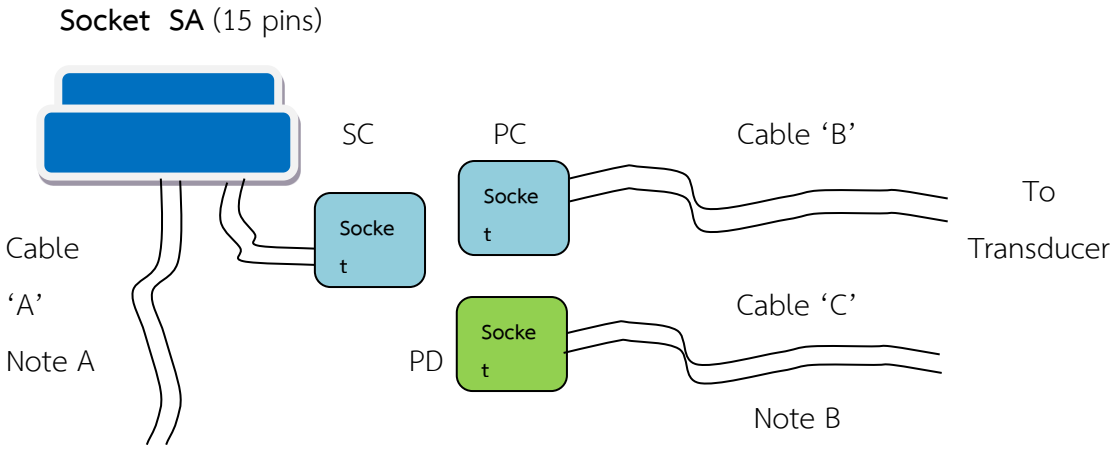


Figure 3: 3-Board exploded view

8. THE WIRING DIAGRAM FOR TAXI METER

Figure 4: Wiring Diagram for TAXI METER



Note A

Individual wires coded as follows: GREY/WHITE = Tariff 1

RED = 12V (Positive)

Note B: CABLE 'C' is used for cars with

BLACK = 0V (Ground)

YELLOW = Not for Hire lamp

GREY = Tariff.

Electronic Speedometer outputs e.g.XD/XE Falcon. GREEN = 0V; PURPLE = Output of electronic is now selected, indicated by the VAC LED (light emitting diode) being lighted.

NB During installation connect Socket SA into Plug PA (back of taxi meter) and all necessary external lamps as listed in Note A. Connect Socket SC to EITHER Plug PC or PD depending on whether the vehicle has the transducer fitted or incorporates an electronic speedometer.

9. HOW TO OPERATE THE TAXI METER

9.1 To initiate a hiring Assume the TAXI METER is in the NFH mode, (This is signified by all displays being blank except for the decimal points, green & red) press the NFH/VAC switch, VAC mode is now selected, indicated by the VAC LED (light emitting diode) being lighted. Select the desired / appropriate tariff by pressing the TARIFF switch. Note that the TAXI METER always remembers the last tariff selected.

Press the FARE switch (marked in red so that it is distinctive) and the following occur: a) The flag fall is loaded & displayed in the fare display. b) The HIRED LED is lighted & this implies TIME & DISTANCE is ON. Hereon, depending on the time & distance rates the appropriate drops would be added to the fare.

9.2 To add EXTRA

If required red, press the EXTRA switch to add the required number of extras to the extras display.

9.3 To proceed to STOP mode

A) Assume that driver has to stop to fill his petrol tank. Press the FARE switch and the following will occur:

a) The STOP LED lighted up

b) TIME is OFF but DISTANCE is ON

Then, when ready, press FARE again to revert to the HIRED mode. i.e. TIME & DISTANCE are both ON again.

B) To end the hiring. Assume the passenger has arrived at the destination. Press FARE to select STOP mode. a) If there is no EXTRA, merely collect the fare and then press NFH/VAC to revert to VAC mode, in anticipation of another hiring. If no further hiring are desired, press NFH/VAC to select the NFH (Not For Hire) mode. b) If there is extras and if desired (to facilitate addition of EXTRAS to the FARE), press the TOTAL/MEM switch. This causes the extras to be added to the main fare and the total displayed in the FARE display. If the passenger wishes to see the EXTRAS and FARE/SEPERATELY, simply press the TOTAL/MEM switch. Otherwise, the driver merely collects the fare and presses the NFH/VAC switch to revert back to the VAC mode.

9.4 If passenger elects to CONTINUE JOURNEY

If after pressing TOTAL/MEM and the EXTRAS is summated to the main fare, the passenger decides that he/she prefers to proceed further, merely press the fare switch to revert back to the HIRED mode. Also the summated fare is automatically split into the main fare in the FARE display and the EXTRAS in the extras displays. However, if the driver FORGETS to press the FARE switch, to revert to the HIRED mode, (presently being in the STOP mode) the TAXI METER, due to its advanced design, will automatically revert to the HIRED mode after the first drop thereafter. Hence this feature is an advantage to the driver.

Please Note: a) The totaling function ie. When TOTAL/MEM is pressed to summate extras to the main fare, this is only valid in the STOP mode. b) Examination of contents in memory can ONLY be accomplished in the VAC mode. For a cross reference of switch function, see “tabulation of switch functions in various modes” Table 1.

10. PROCEDURE TO CALIBRATE THE TAXI METER FOR ANY VEHICLE

The prerequisite is that a test distance of 1 Km. must be marked out with appropriate start and end markers. No test instruments or rev. counter is required to perform the calibration exercise. Instead, a very accurate in-built digital rev. counter is provided with the TAXI METER to facilitate this procedure.

11. METHOD:

11.1 Drive the vehicle to the start marker of 1 Km. test run.

11.2 Select VAC mode for meter. If the TAXI METER is in NFH (indicated by all displays being blank except for the green & red decimal points), merely press the NFH/VAC switch.

11.3 Press the TOTAL/MEM switch till the Tariff Display shows the digit 8. Thus memory function 8 is selected (REVSET) and the display should show 550 in the fare section. Press TOTAL/MEM switch once to select memory. Function 9 (REV COUNTER). Note: If at any time memory function 9 is selected & you wish to clear/reset the figures displayed press the NFH/VAC twice; once to get the TAXI METER to the NFH mode, and a second time to select VAC mode. The display should now be blank. A typical instance when this cleaning operation is needed is when rev. counter is checked a few times, it would then have to be cleared at the start marker of the 1 Km. test run.

11.4 The vehicle is then driven till it reaches the end marker. As the vehicle is moving the TAXI METER counts the rev. and the display format in the FARE display is as explained below.

Format: Eg: Digit EDC=635 means 635 complete revs. Digit A=5 means 5/8 of a rev. That is digit A is a 1/8 rev. counter. Therefore, the readout above means 635 & 5/8 rev.

NB. Digit B ie. The 0 is of no significance Ignore it, and is always=0.

11.5 Note down the rev. count in this example 635 & 5/8 is closer to 636, hence we round it to =636 revs.

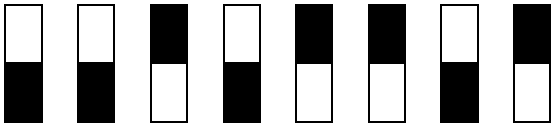
11.6 Next look up the set of “REVSET” Switch Setting chart for the number 636 in the “REVS” column. Alongside 636 is the required switch settings for the REVSET Switch S7. (See page for the location of switch S7 on the TAXI METER). Slide the individual switches, where necessary, to conform to the row of setting as shown in the charts.

NB. The power to the TAXI METER can remain connected whilst the switches are being set.

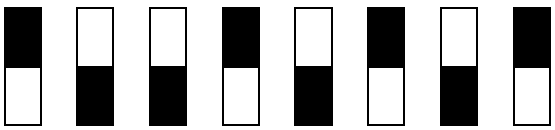
E.g. S7

REVS “REVSET” Switch Settings

625 OFF OFF ON OFF ON ON OFF ON



636 ON OFF OFF ON OFF ON OFF ON



11.7 Press the NFH/VAC switch to select VAC mode. Then TOTAL/MEM switch till memory function 8 is shown the Tariff display.ie. REVSET function. The Fare display should now be 636. The TAXI METER is thus calibrated to a rev. setting of 636 revs./Km. for the particular vehicle. NB. If the display does not show the correct rev.setting.

a) Check that the switch settings of S7 correspond to those shown in the revset chart alongside the measured rev. count.

b) Check that the individual switched of S7 are fully “engaged” in position.

12. CONCLUSION The article showed the basic systematic functions, switch functions, system diagram of taxi meter including the memory data displays, the display board, CPU board, Input/Output driver board, and for a better comprehension also showing a transducer and a battery connection including the signal lamps for those passengers. Moreover, it was explained all working steps of taxi meter including the setting value of switches fit to any vehicle. The article did not explain about the rate change when the transportation authority allowed changing the fare rate of taxi meter, but it will be written after the research on commercial taxi meter is finished. This article would suggest the ideas for further design as a commercial taxi meter and would be beneficial to interested persons, and hopefully it would be beneficial to electronic engineering students for using these ideas for further researches.

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