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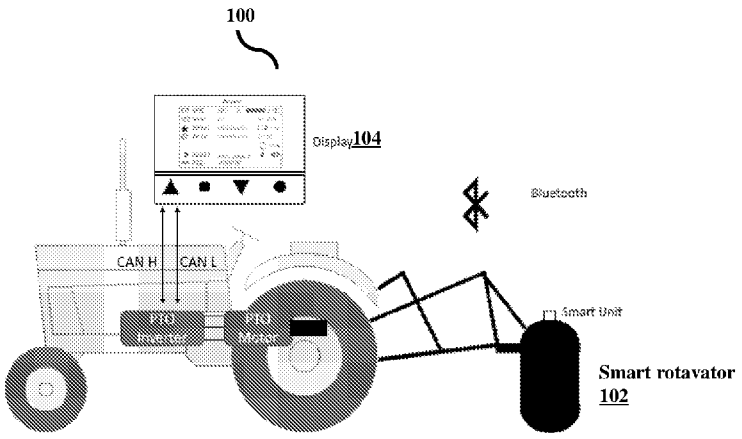

FIG. 2

(57) Abstract: The disclosure herein generally relates to rotavators and more particularly, to a system (100) and a method (200) for managing a speed of the rotavator in accordance with the soil condition. The system (100) includes a display cum controller (104), a Power Take Off (PTO) inverter (106), and a PTO motor (108). The rotavator (102) communicates with the display cum controller (104) through a communication module. The display cum controller (104) regulates speed of the rotavator (102) by directing the PTO inverter (104) to operate PTO motor (108) to increment or decrement speed of a PTO shaft thereby rotating a blade shaft of rotavator (102) at predefined speed corresponding to nature of soil. The proposed system (100) eliminates a use of multi-gear rotavator system which automatically adjusts its speed based on an input variant and a rotor gear.

[Continued on next page]

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— *as to the identity of the inventor (Rule 4.17(i))*
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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"SYSTEM AND METHOD FOR MANAGING SPEED OF ROTAVATOR"

CROSS REFERENCE TO RELATED APPLICATION

This application is based on and derives the benefit of Indian Application 202241066359 filed on 18th November 2022, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

[001] Embodiments herein generally relate to rotavators and more particularly, to a system and a method for managing speed of the rotavator in accordance with the soil condition.

BACKGROUND

[002] A rotavator is a secondary tillage implement which is mainly used for pulverization of a soil. The rotavator takes power from a Power take off (PTO) shaft which rotates the rotavator. The speed of a rotavator blade for different soil condition plays an important role in quality of the operation. It is very important to operate the rotavator at an optimal RPM to get better pulverization, less fuel consumption and better area coverage in accordance with the soil condition. For different soil conditions there is need of different rotavator blade speed since at different soil conditions there are different forward speed of a tractor. The ratios between the forward speed of tractor and the speed of the rotavator blade speed have to be maintained in accordance with the soil condition.

[003] In order to overcome the above mentioned problem, rotor gears are attached in a muti-speed rotavator variant in which a user can get different rotavator blade RPM according to the soil condition (e.g. hard soil condition, medium soil condition, soft soil condition or the like). Multi speed rotavator have few limitations as mentioned below:

1. The rotors gears have to be changed manually which is a drudgery process.
2. This effect the timeliness of an operation during a peak season mostly for rental farming.
3. It is a time-consuming process and sometimes there is also loss of lubricant oil during this changing process.

OBJECTS OF THE DISCLOSED EMBODIMENTS

[004] The principal object of the embodiments herein is to provide a display cum controller which takes few inputs from a user, wherein the display cum controller regulates a speed of the rotavator by directing a power take off (PTO) inverter to operate a PTO motor which in turn rotates a PTO shaft at a predefined speed (optimal speed).

[005] Another object of the embodiments herein is provide the display cum controller which automatically adjusts speed of the rotavator based on an input variant and a rotor gear.

[006] Another object of the embodiments herein is alert the user when the operating speed of the rotavator is different from the determined predefined speed.

[007] Another object of the embodiments herein is provide the display cum controller which displays the speed of rotavator (102), a mode of a gear, total trip information, a battery status, a usage of the communication module, an oil level, an alternative energy usage information, and charging indication.

BRIEF DESCRIPTION OF FIGURES

[008] Embodiments herein are illustrated in the accompanying drawings, throughout which like reference letters indicate corresponding parts in the various figures. The embodiments herein will be better understood from the following description with reference to the drawings, in which:

[009] FIG. 1 depicts an overview of a system in which a display cum controller regulates a speed of a rotavator , according to embodiments as disclosed herein;

[0010] FIG. 2 depicts an example system in which the display cum controller regulates the speed of the rotavator, according to embodiments as disclosed herein;

[0011] FIG. 3 illustrates a hardware architecture of the display cum controller, according to embodiments as disclosed herein;

[0012] FIG. 4 illustrates screen information of the display cum controller, according to embodiments as disclosed herein;

[0013] FIG. 5 and FIG. 6 are example illustrations in which the display information is presented on a user interface of the display cum controller, according to embodiments as disclosed herein;

[0014] FIG. 7 depicts example closed loop system/operations in which the proposed display cum controller regulates the RPM of the rotavator, according to embodiments as disclosed herein; and

[0015] FIG. 8 depicts a flowchart indicating steps of a method for regulating speed of the rotavator, according to embodiments as disclosed herein.

DETAILED DESCRIPTION

[0016] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0017] Embodiments herein disclose a system for managing a speed of a rotavator. The system (100) includes a display cum controller, a Power Take Off (PTO) inverter, and a PTO motor. The rotavator communicates with the display cum controller through a communication module (e.g., short range communication module or the like). The display cum controller regulates Revolutions Per Minute (RPM) of the rotavator by directing the PTO inverter to operate a PTO motor to increment or decrement the speed of a PTO shaft thereby rotating a blade shaft of the rotavator at the predefined speed corresponding to the nature of soil at a predefined speed. The display cum controller is communicated with the PTO inverter through a Controller Area Network and the PTO inverter provides an input to the PTO motor to manage the predefined speed of the rotavator.

[0018] The proposed display cum controller which takes few inputs from the user, and regulates the RPM of the rotavator as well as directs the PTO inverter to operate the PTO motor to increment or decrement the speed of a PTO shaft thereby rotating a blade shaft of the rotavator at the predefined speed corresponding to the nature of soil. The predefined speed of the rotavator is determined based on a nature of a soil, wherein a range of the predefined speed of the rotavator (102) is 160 rpm to 180 rpm, upon the obtained information by the display cum controller (104) indicates the soil is a hard soil, wherein a range of the predefined speed of the rotavator (102) is 180 rpm to 200 rpm, upon the obtained information by the display cum controller (104) indicates the soil is a medium soil, and wherein a range of the predefined speed of the rotavator (102) is 210 rpm to 230 rpm, upon the obtained information by the display cum controller (104) indicates the soil is a soft soil.

[0019] The proposed display cum controller has an advantage over an existing rotavator system wherein a mobile system is eliminated in the architecture because of the following reasons: Advantage of buzzer display over the phone:

1. In many households there is one smart phone but multiple drivers/operators, hence a device for the same is more useful.
2. While operating the tractor driver finds it difficult to monitor RPM on the smart phone.
3. Risk of smart phone getting dropped is not there.
4. Using the mobile phone, farmer cannot connect with other BLE enabled system, which is now possible using the proposed display.

[0020] The present system displays all the features same as smart rotavator and also it directs the PTO inverter to work according to the different soil RPM requirement.

[0021] Referring now to the drawings, and more particularly to FIGS. 1 through 8, where similar reference characters denote corresponding features consistently throughout the figures, there are shown preferred embodiments.

[0022] FIG. 1 depicts an overview of a system (100) in which a display cum controller (104) regulates a speed (RPM) of a rotavator (102), according to embodiments as disclosed herein. FIG. 2 depicts an example system (e.g., tractor or the like) in which the proposed display cum controller (104) regulates the speed of the rotavator (102) as well as directs the PTO inverter to operate at the predefined speed, according to embodiments as disclosed herein. The tractor can be, for example, but not limited to electric tractors, internal combustion engine (ICE) tractors and battery based electric tractors.

[0023] In an example, the system (100) includes the display cum controller (104), the PTO inverter (106) and a PTO motor (108). The smart rotavator (102) is communicated with the display cum controller (104) through a communication module (e.g. short range communication module or the like). The short range communication module can be, for example, but not limited to, a Bluetooth communication module, an infrared communication module, a near-field communication module, an ultra-band communication module, an ultrawide band (UWB) communication module, a Zigbee module or the like. The display cum controller (104) is communicated with the PTO inverter (106) through a Controller Area Network (CAN-H) and a CAN-L. The PTO inverter (106) provides an input signal to the PTO motor (108) to manage the predefined speed of the smart rotavator (102).

[0024] In an example, the smart rotavator (102) sends a speed of a rotavator blade (not shown) via the Bluetooth module to the display cum controller (104). The display cum controller (104) maps an input speed with the corresponding selected rotor gear (not shown) by the user. The information of the selected rotor gear and RPM is depicted in the FIG. 6 and FIG. 7. Further, according to soil condition, the rotor gear have to be selected. Upon selection of the rotor gear, the display cum controller (104) takes the input and maps the variant speed versus a predefined speed of a rotavator blade (i.e., the difference between the input speed and the predefined speed is taken as the error. The error is passed on the PTO inverter (104) for increment or decrement in a PTO speed. The middle value of the predefined speed range is given to the PTO inverter (106) and the rotavator speed is monitored as a closed loop system as shown in the FIG. 3. The heterogenous nature of soil doesn't allow the rotavator (102) to operate at the predefined speed, hence the closed loop system is designed as such that there is continuous monitoring of the same in the real time and predefined speed is achieved.

[0025] The display system eliminates the use of multi-gear rotavator system which automatically adjusts its speed based on an input variant and rotor gear. The system reduces the drudgery, saves time, and eliminate the spillage of lubricant oil while changing the rotor gears for getting different speed according to soil condition. Better productivity, high field capacity and less fuel consumption also increases productivity of the operation for rotavator. The display system is an alternate to mobile system because of following reasons:

1. In many households there is one smart phone but multiple drivers/operators, hence a device for the same is more useful.
2. While operating the tractor driver finds it difficult to continuous monitor RPM on phone.
3. Risk of smart phone getting dropped is not there.
4. Using mobile phone, farmer cannot connect with other BLE enabled system, which is now possible using this display.

[0026] The proposed system (100) can be a wrist band and includes a magnet at back to attach it with instrument cluster. The display can be tied on a neck.

[0027] FIG. 3 illustrates a hardware architecture of the display cum controller (104), according to embodiments as disclosed herein. The display cum controller (104) includes a

battery charger chip, a transient protection, a USB port, a battery status monitoring, an ON/OFF switch, a buzzer and the display. The battery charger chip charges the battery of the display cum controller (104) through the USB port and ON-OFF switch. The battery status monitoring monitors the battery level. The transient protection unit re-directs an energy in transients by utilizing the differences between a transient and an intended signal waveform.

[0028] FIG. 4 illustrates screen information of the display cum controller (104), according to embodiments as disclosed herein. The display cum controller (104) includes a power switch, an up-switch, a down-switch, a select switch, a USB charging port, a battery, a LED indication, a buzzer, a charging indication, a device vibrator, and a display. The power switch is used for power ON/power OFF the display cum controller (104). The up-switch, the down-switch, and the select switch are used when a user of the display cum controller (104) does the operation manually. The USB charging port is used for charging the battery. The LED indication is used for indicating the nature of the soil (e.g. hard soil, a medium soil, soft soil or the like). The charging indication is used for indicating the level of the charging. The buzzer and the device vibrator are used for alerting the user when the speed of the rotavator blade is not in the predefined speed in accordance with the soil condition.

[0029] FIG. 5 and FIG. 6 are example illustrations (600 and 700) in which the display information is presented on a user interface of the display cum controller (104), according to embodiments as disclosed herein. In an example, the user interface displays the RPM, a mode of the gear, total trip information, a battery status, a usage of the short range communication module, an oil level, an alternative energy usage information, and charging indication.

[0030] FIG. 7 depicts example closed loop system/operations in which the proposed display cum controller (104) regulates the RPM of the rotavator (102), according to embodiments as disclosed herein. FIG. 8 depicts a flowchart indicating steps of a method (300) for regulating speed of the rotavator (102), according to embodiments as disclosed herein. In an embodiment, at step (302), the method (300) includes, obtaining, by a display cum controller (104), information about a nature of a soil. At step (304), the method (300) includes, determining, by the display cum controller (104), a predefined speed of the rotavator (102) based on the obtained nature of the soil. At step (306), the method (300) includes, comparing, by the display cum controller (104) an operating speed (input speed) of the rotavator (102) with the determined predefined speed of the rotavator (102). At step (308), the method (300) includes, determining, by the display cum controller (104), an error

in the speed based on a result of the comparison. At step (310), the method (300) includes, sending, by the display cum controller (104), a control signal to the PTO inverter (106) based on the determined error. At step (312), the method (300) includes operating, by the PTO inverter (106), the PTO motor (108) to increment or decrement the speed of a PTO shaft based on the control signal from the display cum controller (104). At step (314), the method (300) includes controlling, by the PTO motor (108), a rotation of a blade shaft of the rotavator (102) at the predefined speed based on the increment or decrement of the speed of the PTO shaft by the PTO motor (108).

[0031] Further, the method (300) includes indicating, by a user interface of the display cum controller (104) the speed of the rotavator (102), a mode of a gear, total trip information, a battery status, a usage of the short range communication module, an oil level, an alternative energy usage information, and charging indication. Furthermore, the method (300) includes alerting, by at least one of a buzzer or a device vibrator, when the operating speed of the rotavator is different from the determined predefined speed.

[0032] The embodiments disclosed herein can be implemented through at least one software program running on at least one hardware device and performing network management functions to control the network elements. The elements shown in FIG. 1 include blocks which can be at least one of a hardware device, or a combination of hardware device and software module.

[0033] Therefore, it is understood that the scope of the protection is extended to such a program and in addition to a computer readable means having a message therein, such computer readable storage means contain program code means for implementation of one or more steps of the method, when the program runs on a server or mobile device or any suitable programmable device. The method is implemented in a preferred embodiment through or together with a software program written in example Very high speed integrated circuit Hardware Description Language (VHDL), or any other programming language, or implemented by one or more VHDL or several software modules being executed on at least one hardware device. The hardware device can be any kind of portable device that can be programmed. The device may also include means, which could be, for example, a hardware means, for example, an Application-specific Integrated Circuit (ASIC), or a combination of hardware and software means, for example, an ASIC and a Field Programmable Gate Array (FPGA), or at least one microprocessor and at least one memory with software modules

located therein. The method embodiments described herein could be implemented partly in hardware and partly in software. Alternatively, the invention may be implemented on different hardware devices, e.g. using a plurality of Central Processing Units (CPUs).

[0034] The technical advantages of the system (100) for managing speed of the rotavator (102) are as follows. The display cum controller automatically adjusts speed of the rotavator based on an input variant and a rotor gear. The buzzer and the device vibrator alerts the user when the operating speed of the rotavator is different from the determined predefined speed.

[0035] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the scope of the embodiments as described herein.

STATEMENT OF CLAIMS

We claim:

1. A system (100) for managing speed of a rotavator (102), the system (100) comprising:

a power take off (PTO) motor (108);

a Power Take Off (PTO) inverter (106) in communication with the PTO motor (108); and

a display cum controller (104) in communication with the PTO inverter (106),

wherein the rotavator (102) communicates with the display cum controller (104) through a communication module.

2. The system (100) as claimed in claim 1, where the display cum controller (104) communicates with the PTO inverter (106) through a Controller Area Network (CAN).

3. The system (100) as claimed in claim 1, wherein the display cum controller (104) is configured to:

obtain information related to a nature of a soil;

determine a predefined speed of the rotavator (102) based on the obtained information related to the nature of the soil;

compare an operating speed (input speed) of the rotavator (102) with the determined predefined speed of the rotavator (102);

determine an error in the speed based on a result of the comparison;

send a control signal to the PTO inverter (106) which in turn operates the PTO motor (108) to increment or decrement a speed of a PTO shaft; and

control rotation of a blade shaft of the rotavator (102) at the predefined speed based on the increment or decrement of the speed of the PTO shaft by the PTO motor (108).

4. The system (100) as claimed in claim 3, wherein a range of the predefined speed of the rotavator (102) is 160 rpm to 180 rpm, upon the obtained information by the display cum controller (104) indicates the soil is a hard soil, wherein a range of the predefined speed of the rotavator (102) is 180 rpm to 200 rpm, upon the obtained information by the display cum controller (104) indicates the soil is a medium soil, and wherein a range of the predefined speed of the rotavator (102) is 210 rpm to 230 rpm, upon the obtained information by the display cum controller (104) indicates the soil is a soft soil.

5. The system (100) as claimed in claim 1, wherein the communication module is a short range communication module, wherein the communication module comprises at least one of

a Bluetooth communication module, an infrared communication module, a near-field communication module, an ultra-band communication module, an ultrawide band (UWB) communication module, or a Zigbee module.

6. The system (100) as claimed in claim 1, wherein the display cum controller (104) comprises a user interface, wherein the user interface displays the speed of rotavator (102), a mode of a gear, total trip information, a battery status, a usage of the communication module, an oil level, an alternative energy usage information, and charging indication.

7. The system (100) as claimed in claim 1 or 3, wherein the display cum controller (104) comprises a buzzer and a device vibrator, wherein each of the buzzer and the device vibrator is configured to alert the user when the operating speed of the rotavator is different from the determined predefined speed.

8. A method (300) for managing speed of a rotavator (102), the method (300) comprising:

obtaining, by a display cum controller (104), information about a nature of a soil;

determining, by the display cum controller (104), a predefined speed of the rotavator (102) based on the obtained nature of the soil;

comparing, by the display cum controller (104) an operating speed of the rotavator (102) with the determined predefined speed of the rotavator (102);

determining, by the display cum controller (104), an error in the speed based on a result of the comparison;

sending, by the display cum controller (104), a control signal to the PTO inverter (106) based on the determined error;

operating, by the PTO inverter (106), the PTO motor (108) to increment or decrement a speed of a PTO shaft based on the control signal from the display cum controller (104) to the PTO inverter (106); and

controlling, by the PTO motor (108), a rotation of a blade shaft of the rotavator (102) at the predefined speed based on the increment or decrement of the speed of the PTO shaft.

9. The method (300) as claimed in claim 8, wherein the rotavator (102) communicates with the display cum controller (104) through a short range communication module, wherein the short range communication module comprises at least one of a Bluetooth communication module, an infrared communication module, a near-field communication module, an ultra-

band communication module, an ultrawide band (UWB) communication module, and a Zigbee module.

10. The method (300) as claimed in claim 8, wherein the method (300) includes,

indicating, by a user interface of the display cum controller (104), the speed of the rotavator (102), a mode of a gear, total trip information, a battery status, a usage of the short range communication module, an oil level, an alternative energy usage information, and charging indication; and

alerting, by at least one of a buzzer or a device vibrator, when the operating speed of the rotavator is different from the determined predefined speed.

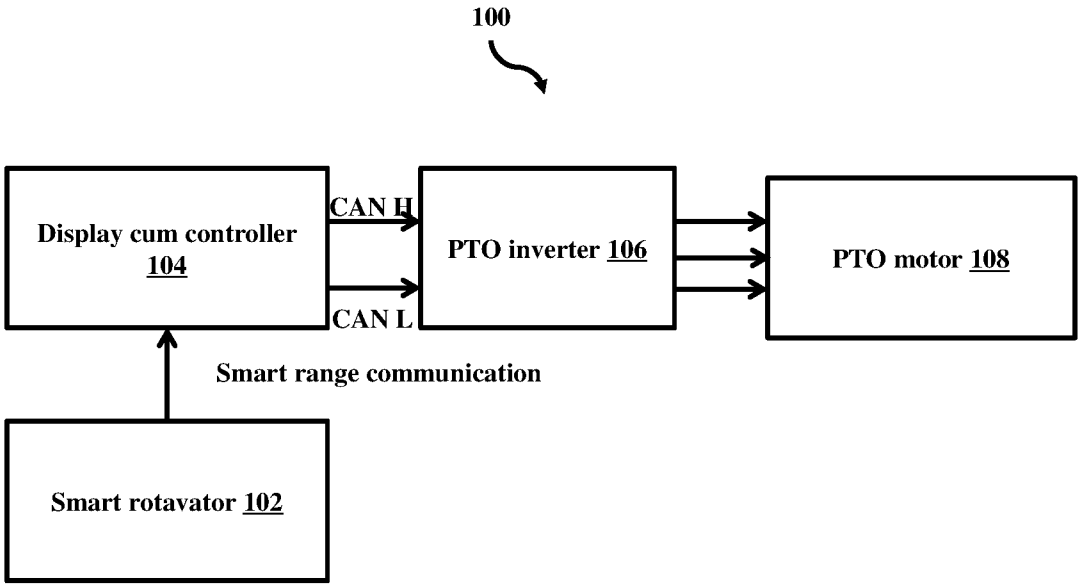
100
Display cum controller 104
CAN H
CAN L
PTO inverter 106
PTO motor 108
Smart range communication
Smart rotavator 102

FIG. 1

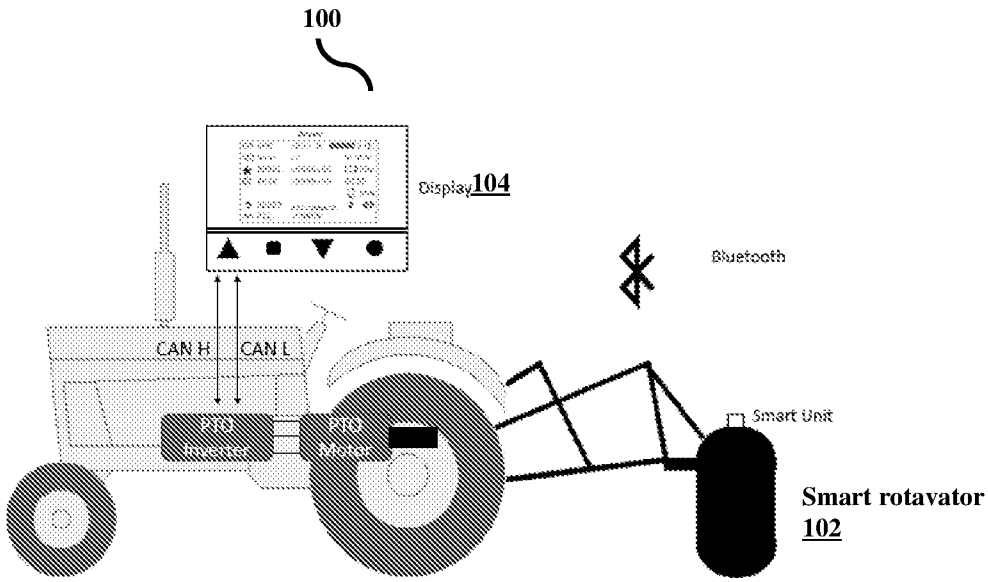
100
Display 104
Bluetooth
CAN H
CAN L
PTO Inverter
PTO Motor
Smart Unit
Smart rotavator 102

FIG. 2

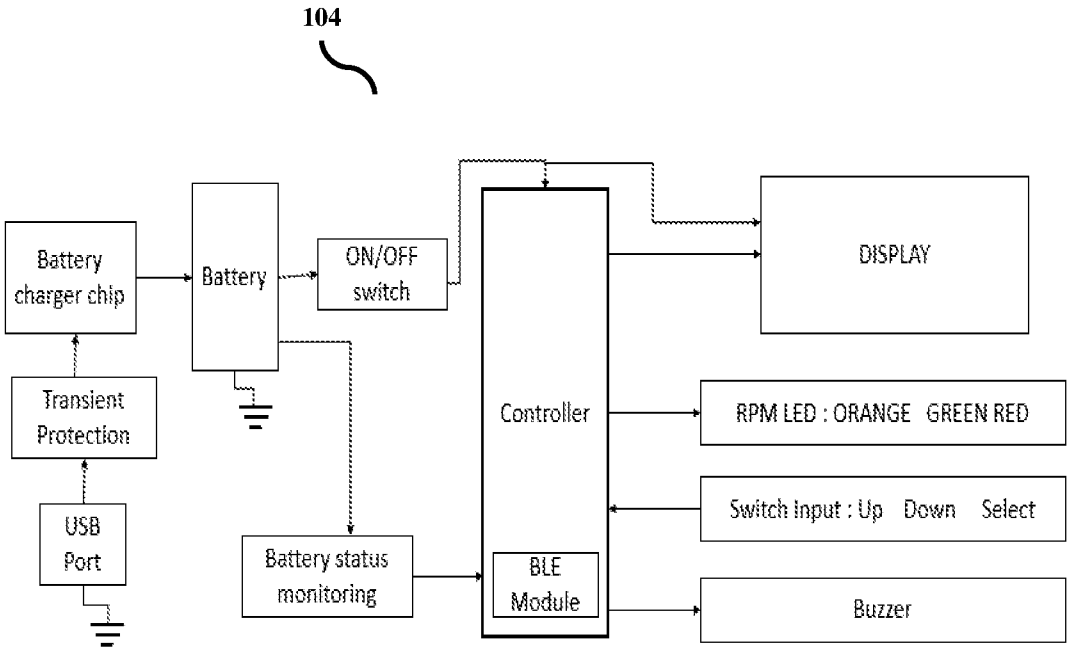
104
Battery charger chip
Battery
ON/OFF switch
DISPLAY
Transient Protection
Controller
RPM LED : ORANGE GREEN RED
USB Port
Switch input : Up Down Select
Battery status monitoring
BLE Module
Buzzer

FIG. 3

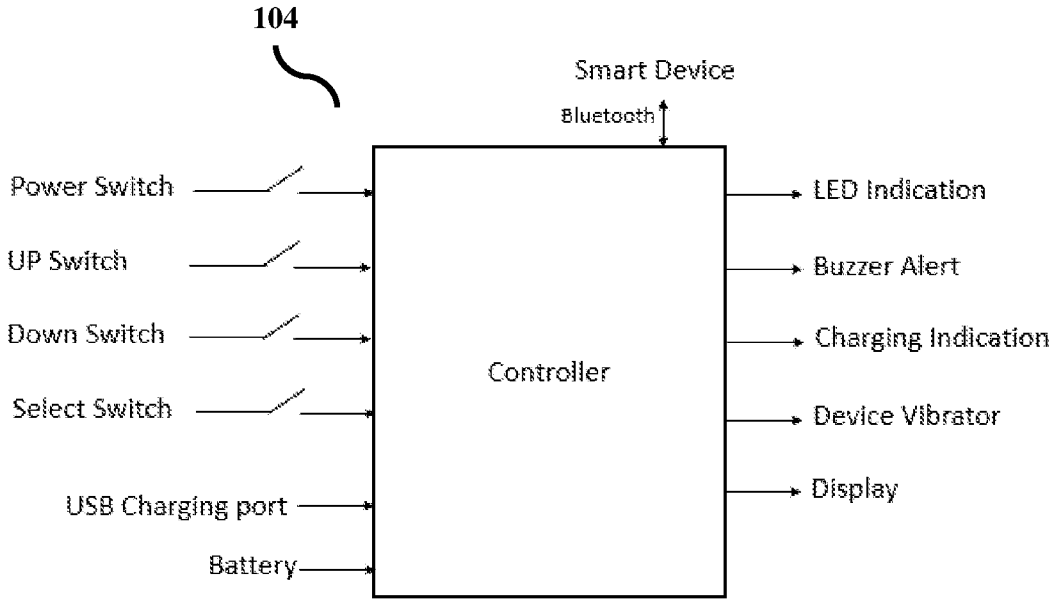
104
Smart Device
Bluetooth
Power Switch
UP Switch
Down Switch
Select Switch
USB Charging port
Battery
Controller
LED Indication
Buzzer Alert
Charging Indication
Device Vibrator
Display

FIG. 4

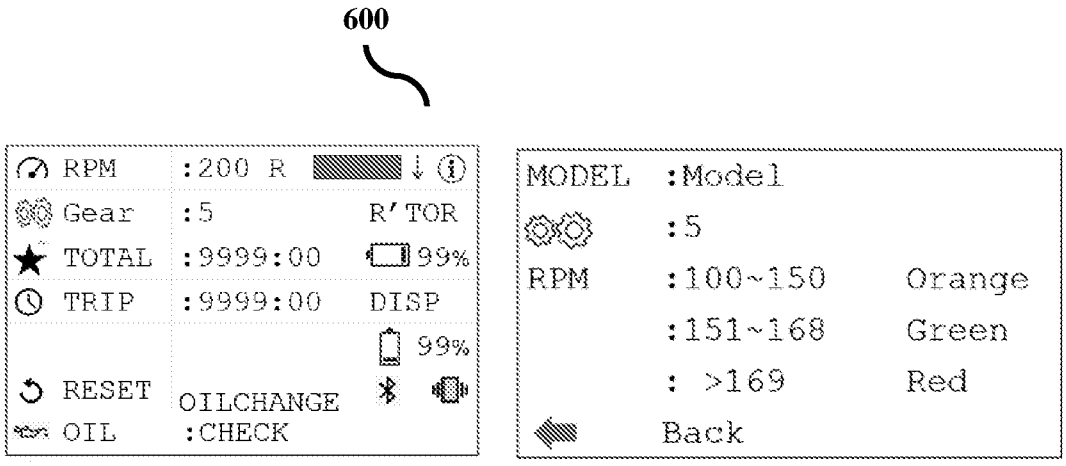
600
RPM :200 R
Gear :5 R'TOR
TOTAL :9999:00 99%
TRIP :9999:00 DISP
99%
RESET OILCHANGE
OIL :CHECK
MODEL :Model
:5
RPM :100~150 Orange
:151~168 Green
: >169 Red
Back

FIG. 5

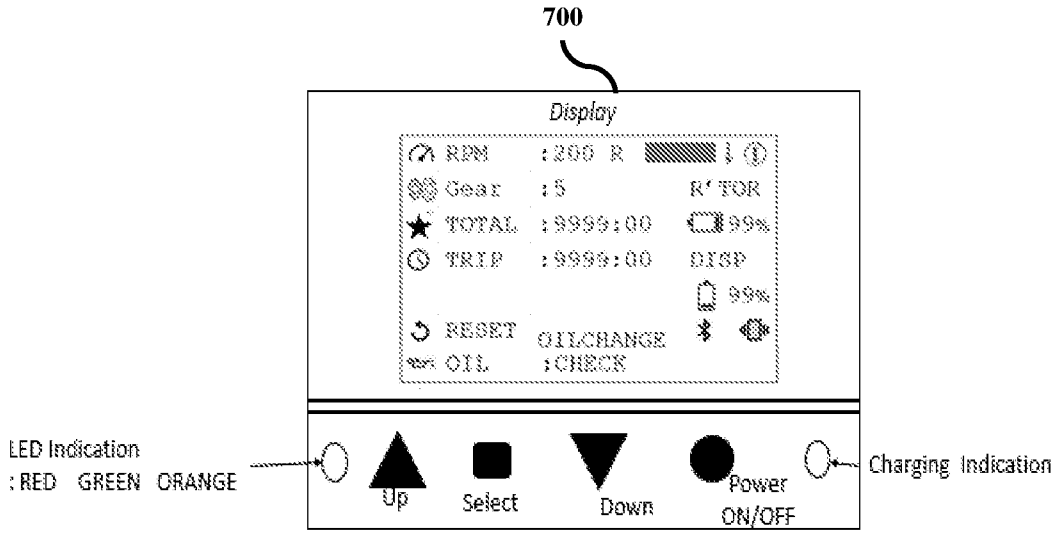
700
Display
RPM :200 R
Gear :5 R'TOR
TOTAL :9999:00 99%
TRIP :9999:00 DISP
99%
RESET OILCHANGE
OIL :CHECK
LED Indication
:RED GREEN ORANGE
Up
Select
Down
Power
ON/OFF
Charging Indication

FIG. 6

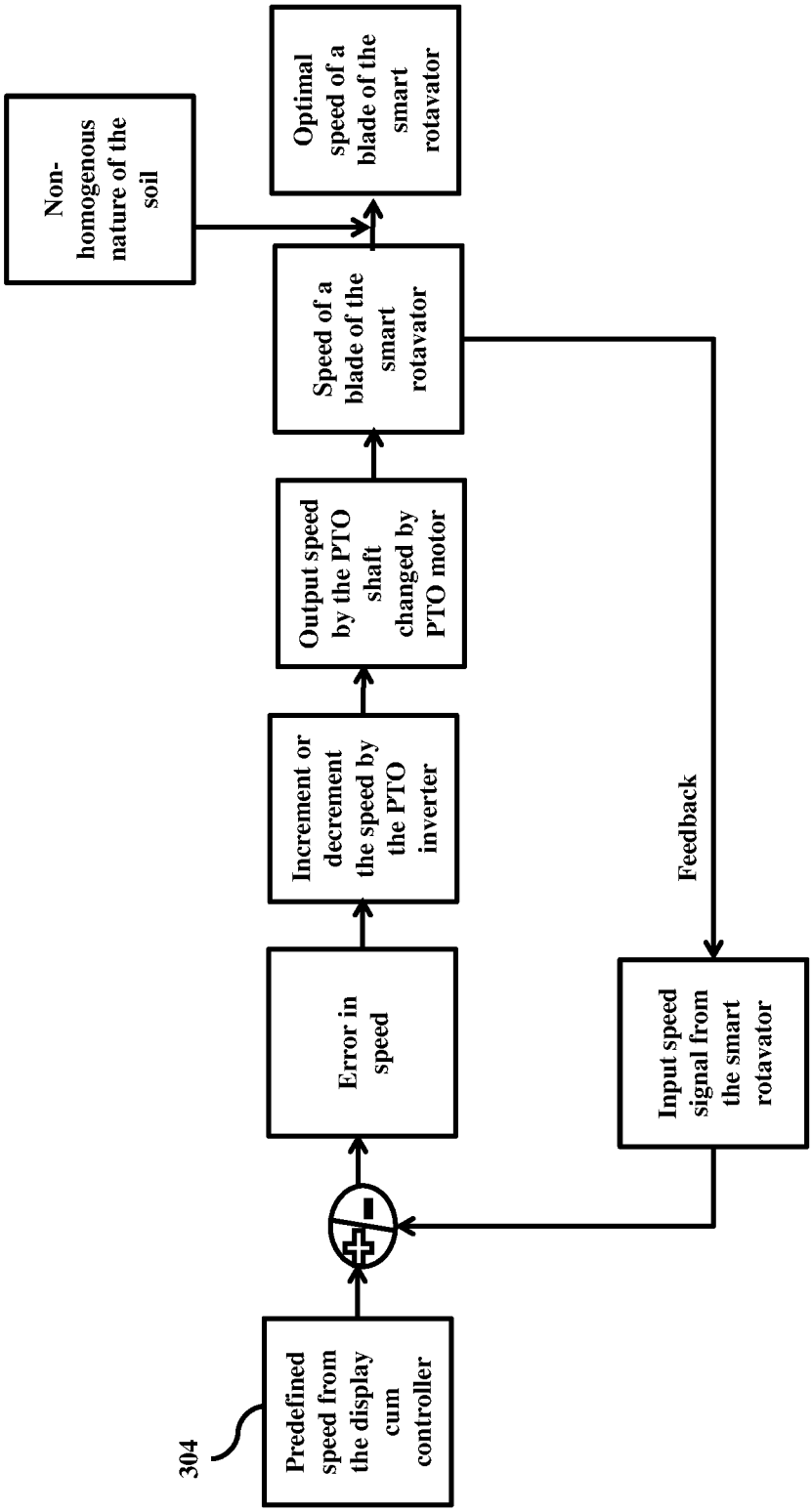
Predefined speed from the display cum controller
304
Error in speed
Increment or decrement the speed by the PTO inverter
Output speed by the PTO shaft changed by PTO motor
Speed of a blade of the smart rotavator
Optimal speed of a blade of the smart rotavator
Non-homogenous nature of the soil
Feedback
Input speed signal from the smart rotavator

FIG. 7

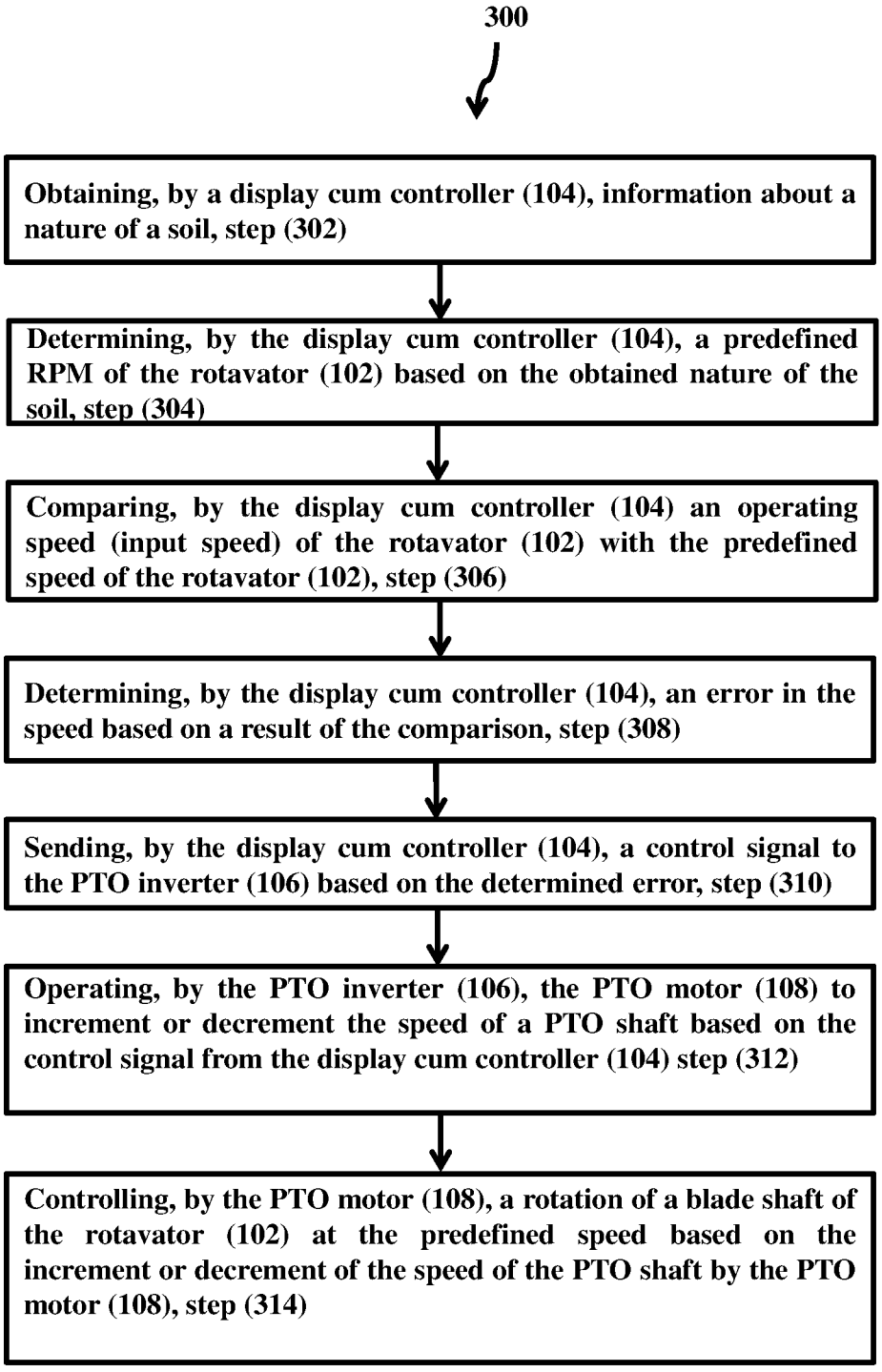
300
Obtaining, by a display cum controller (104), information about a nature of a soil, step (302)
Determining, by the display cum controller (104), a predefined RPM of the rotavator (102) based on the obtained nature of the soil, step (304)
Comparing, by the display cum controller (104) an operating speed (input speed) of the rotavator (102) with the predefined speed of the rotavator (102), step (306)
Determining, by the display cum controller (104), an error in the speed based on a result of the comparison, step (308)
Sending, by the display cum controller (104), a control signal to the PTO inverter (106) based on the determined error, step (310)
Operating, by the PTO inverter (106), the PTO motor (108) to increment or decrement the speed of a PTO shaft based on the control signal from the display cum controller (104) step (312)
Controlling, by the PTO motor (108), a rotation of a blade shaft of the rotavator (102) at the predefined speed based on the increment or decrement of the speed of the PTO shaft by the PTO motor (108), step (314)

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2023/050236

A. CLASSIFICATION OF SUBJECT MATTER
G05B13/02,A01B33/08 Version=2023.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G05B, A01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

Databases: PatSeer, IPO Internal Database
Keywords: speed control, tractor, work vehicle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP4025528B2 (YANMA AGRICULTURAL EQUIPMENT CO LTD) 19 December 2007 (19/12/2007) Paragraphs [0006]-[0021], [0040]-[0053]	1-10
Y	IN202141028053A (MAHINDRA GROUP) 11 March 2022 (11/03/2022) Whole document	1-10
Y	US8160784B2 (KUBOTA CORP) 17 April 2012 (17/04/2012) Columns 17-21; figures 13a-13e	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13-07-2023	13-07-2023

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2023/050236

Citation	Pub.Date	Family	Pub.Date
US 8160784 B2	17-04-2012	US 20090248258 A1	01-10-2009